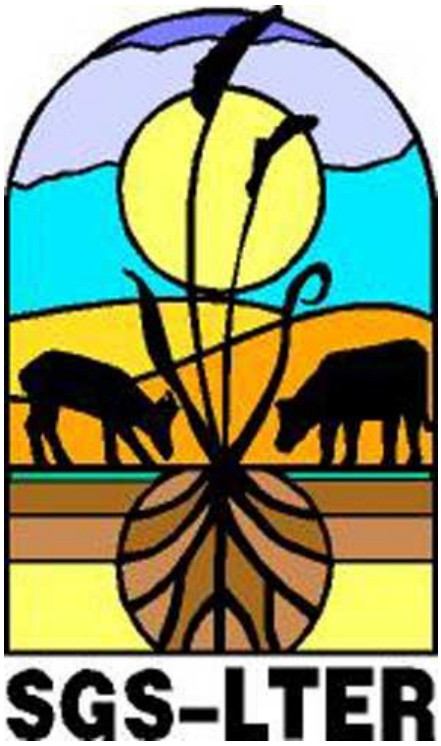

Colorado State University
Knowledge to Go Places

Shortgrass Steppe Long Term Ecological Research Project

2010
Field Crew Sampling Protocols

Nicole Kaplan, SGS-LTER Information Manager

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SGS/LTER Field Staff & Research Assistants 2010

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

SGS/LTER Field Research Staff

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

Field Crew Leader: Kevin Meierbachtol

Assistant Crew Leader: Trace Martyn

SGS/LTER Research Assistants (May 17 to August 22)

Melissa Perkins
Andrew Beach
Brian Gley

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

SGS-LTER HOUSE RULES

Kitchen:

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

Field Station Conference, Laboratory, and Bathrooms:

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

Dormitory Rooms:

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

Computer and Office Space:

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

Instructions for Hardwire Connections

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

Instructions for Wireless Connections

1. Open your wireless network settings as follows:
   Click **Start>Control Panel>Network Settings**
   Double Click **Wireless Network Connections**
2. Click **View Wireless Networks**
3. Double Click **sgslter** network box

Enter this network key (and in confirm box too): **16AB845E0C** (Note the 0 is numeric zero)
Click **Connect (NOTE YOU WILL ONLY NEED TO RUN THE ABOVE STEPS ONCE. Afterwards your wireless will connect automatically.)**

SGS/LTER Field Crew Guidelines

Work Schedule

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

Duties

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

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

Driving Rules

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

Personal Equipment

Extra Clothing: Shell/Windbreaker (Preferably Waterproof)
Sweater
Warm Hat
Sun Hat
Work Gloves
Long Pants
Sunglasses
Sunscreen
Personal Water Bottles
Cactus Proof Footwear

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

SGS-LTER Guidelines for Field Safety and Courtesy

NO PETS ALLOWED!

Roadways:

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

Medical Dangers and Precautions

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

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

ROAD POLICY FOR CENTRAL PLAINS EXPERIMENTAL RANGE (CPER)

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

Established roads are characterized by the complete lack of vegetation in the wheel tracks. A current map of the established roads can be found at the following website: http://limberpine.cnr.colostate.edu/About/SiteLocatorMap/SiteLocatorMap.htm. When working in an area, vehicles should be parked immediately adjacent and parallel to the established road to facilitate travel on the road by other personnel. When turning a vehicle around, please back up until perpendicular to the road and then proceed forward to the road. In all cases, please minimize the area that is disturbed when turning vehicles around.

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

TRAVEL ON THE PAWNEE GRASSLAND

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

Phenology

Principal Investigator(s): Bill Lauenroth (and Lynn Moore, Graduate Student)
Study Objectives: to study the life stages of 22 individuals of different species of plants through the growing season.

What to know before you start sampling:

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

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

Experimental Design:

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

Sampling Protocol:

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

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

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

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

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

QAQC Instructions:

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

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

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

Data Sheet(s):

PHENOLOGY STUDY

Date: **Location:** **Recorder:**

GRASSES AND GRASSLIKES

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

***only sample in wet years**

FORBS AND SHRUBS

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

PHENOLOGY CODE:

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

ARS #03 Ecosystem Stress Area (ESA)

Principal Investigator: Daniel.Milchunas@colostate.edu

Study Objectives: to conduct long-term monitoring of the vegetative characteristics of an area that was nutrient stressed during the International Biome Project. Sampling is conducted once a year in the two control plots (D1 and D2 on the map). All treatments and reps as well as the grub kill plots are sampled every five years (2007, 2012, 2017, 2022…).

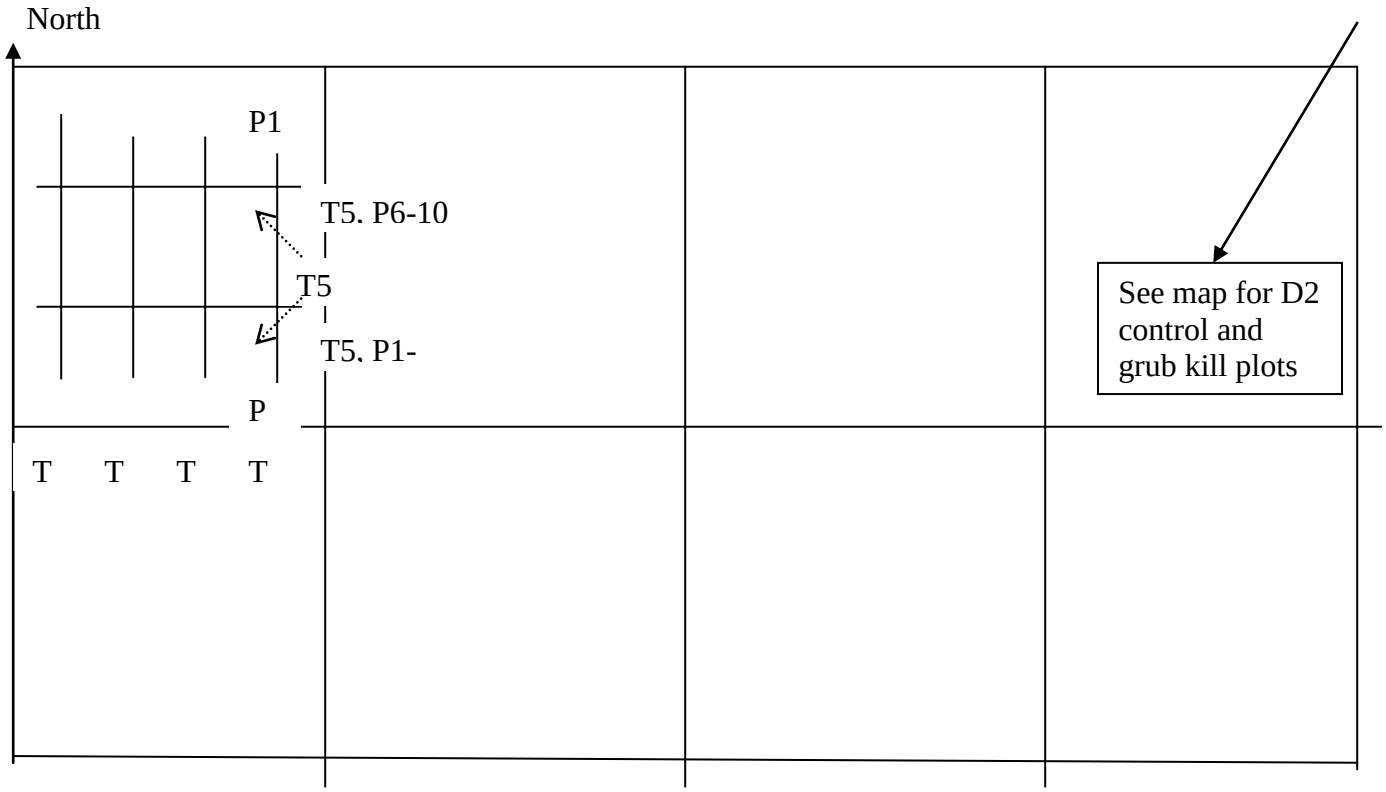
Study Area Location and Design

Blocks – There are 2 blocks, one to the east and one to the west. Data need to be collected in a total of 9 areas every five years and **only in control plots every year (D1 and D2)**. 2 reps repeat the same treatment (D1 control, D2 control, E1 irrigation, E2 irrigation, F1 fertilization, F2 fertilization, G1 irrigation and fertilization, G2 irrigation and fertilization). In addition, there is a part of D2 that contains the grub kill. The area that contains the grub kill should be recorded as D2-G on all data sheets. The grub kill plots are marked with tent stakes rather than rebar and need to be identified with unique flagging.

Transects 1-5 – see transect lines below. The transects in the grub kill area of D2 are recorded as "G". Plot numbers range from 1-50 in the grub kill area of D2 only. Note the fifty plots in the D2 grub kill area do not follow the standard design below. Please follow the attached map for the D2 and grub kill plots.

Plots 1-10 – see plots below. Permanent plots were established by installing transects marked with rebar. Each rebar should have a blaze orange plastic cap. The transect and plot numbers need to be re-written on each cap with sharpie prior to sampling.

Important: these are permanent plots, so it is very important that plot numbers and transects are always recorded correctly. *Please note that the Humus Experimental plots are also located within seven of the eight ESA blocks. Be careful not to tread across the Humus Plots. See Mark, Nicole, or Indy (PI) to find out how the humus plots are set up.



Equipment
Circular ¼ m2 quadrat frame
Ten point frame
Datasheets
Maps of ESA treatment, and grub kill area
Check off sheet for QAQC

Density Sampling Protocol
A 0.25 m^2 circular quadrat with four quarter plots is placed with the cross bars in the northeast corner. Collect data starting in the northeast quarter plot (1) and work your way around clockwise to #4. Count all of the individuals of each species rooted within each quarter plot and record the data under the appropriate quarter plot number. Use the species column to record the correct species code. If a species is not found in a quarter plot, then enter a "0" in that cell on the data sheet. We do not count the number of individuals of Bogr or Buda (they are sampled by point frame method below). OPPO is counted as the number of live cladodes, bunch grasses as the number of clumps, and all individual tiller/shoot species as the number of stems emerging from the ground (at ground-surface level).

Point Frame Sampling for Basal Cover Protocol
Use the ten point frame to estimate cover at each plot location. The point frame should be placed where the rebar is near the middle of the frame, and the points fall across the middle of the circular quadrat location (the points span the middle of the quadrat). This will provide a total of 10 points of contact for each plot. The categories to record are plant species code, litter (code = litt), bare ground (code = bare), and lichen (code = pach). Be very critical about what the contact really is. If the tip intercepts old dead crown and cladodes record it as litter. Recent dead is considered live that year and is not 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. Do not start work until you have been shown how to classify BOGR crowns versus BARE and LITT.

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 plots have been sampled. These are permanent plots. It does matter how they are coded each year on the data sheet with correct block, treatments codes, as well as transect and plot numbers (plot number 1, 2, 3,… has to always be the same number each year. Check to see that you have collected density and point-frame data from all 50 plots from the treatment/replicate on which you are working before moving to the next (last team (2 people) leaving the treatment/rep should be handed everyone's data sheets to be checked. There should be 5 transects each with 10 quadrats (plots), and each frame with 10 points, Do not have two teams working along one transect in leap-frog pattern as plot numbers can get confused.. CAN OTHER PEOPLE UNDERSTAND YOUR WRITING ??? **Complete the check-off sheet at end of collecting all data** even though it was checked in the field before leaving a treatment/rep.

Data Sheets

ARS Study #3 (ESA) PI – Dan Milchunas

Recorder_____ Page ___of___
Data Entered By_____ Date of Collection_____

Density

Site	Data Type	Month	Year	Treatment	Rep	Transect		Plot	Species	Quarter Plot 1	2	3	4	Notes

ARS Study #3 (ESA)   PI – Dan Milchunas

Recorder___________   Page ___of___
Data Entered By________   Date of Collection______

Point Frame

Site	Data Type	Month	Year	Treatment	Rep	Transect	Plot	Species	Basal Dots	Cover Count	Notes

Check-off Sheet for Control Plots Sampled Every Year

1D	2D
1-1	1-1
1-2	1-2
1-3	1-3
1-4	1-4
1-5	1-5
1-6	1-6
1-7	1-7
1-8	1-8
1-9	1-9
1-10	1-10
2-1	2-1
2-2	2-2
2-3	2-3
2-4	2-4
2-5	2-5
2-6	2-6
2-7	2-7
2-8	2-8
2-9	2-9
2-10	2-10
3-1	3-1
3-2	3-2
3-3	3-3
3-4	3-4
3-5	3-5
3-6	3-6
3-7	3-7
3-8	3-8
3-9	3-9
3-10	3-10
4-1	4-1
4-2	4-2
4-3	4-3
4-4	4-4
4-5	4-5
4-6	4-6
4-7	4-7
4-8	4-8
4-9	4-9
4-10	4-10
5-1	5-1
5-2	5-2
5-3	5-3
5-4	5-4
5-5	5-5
5-6	5-6
5-7	5-7
5-8	5-8
5-9	5-9
5-10	5-10

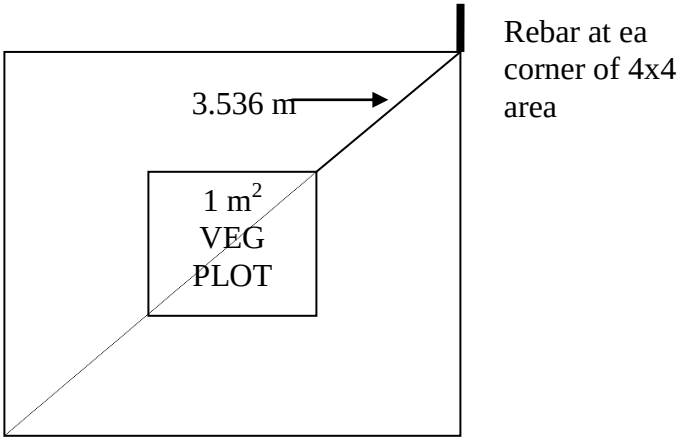
Check-off Sheet for All Sampling that occurs every 5 years – beginning 2007

1D	1E	1F	1G	2D	2E	2F	2G	Grub
1-1	1-1	1-1	1-1	1-1	1-1	1-1	1-1	1
1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	2
1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	3
1-4	1-4	1-4	1-4	1-4	1-4	1-4	1-4	4
1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	5
1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	6
1-7	1-7	1-7	1-7	1-7	1-7	1-7	1-7	7
1-8	1-8	1-8	1-8	1-8	1-8	1-8	1-8	8
1-9	1-9	1-9	1-9	1-9	1-9	1-9	1-9	9
1-10	1-10	1-10	1-10	1-10	1-10	1-10	1-10	10
2-1	2-1	2-1	2-1	2-1	2-1	2-1	2-1	11
2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	12
2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	13
2-4	2-4	2-4	2-4	2-4	2-4	2-4	2-4	14
2-5	2-5	2-5	2-5	2-5	2-5	2-5	2-5	15
2-6	2-6	2-6	2-6	2-6	2-6	2-6	2-6	16
2-7	2-7	2-7	2-7	2-7	2-7	2-7	2-7	17
2-8	2-8	2-8	2-8	2-8	2-8	2-8	2-8	18
2-9	2-9	2-9	2-9	2-9	2-9	2-9	2-9	19
2-10	2-10	2-10	2-10	2-10	2-10	2-10	2-10	20
3-1	3-1	3-1	3-1	3-1	3-1	3-1	3-1	21
3-2	3-2	3-2	3-2	3-2	3-2	3-2	3-2	22
3-3	3-3	3-3	3-3	3-3	3-3	3-3	3-3	23
3-4	3-4	3-4	3-4	3-4	3-4	3-4	3-4	24
3-5	3-5	3-5	3-5	3-5	3-5	3-5	3-5	25
3-6	3-6	3-6	3-6	3-6	3-6	3-6	3-6	26
3-7	3-7	3-7	3-7	3-7	3-7	3-7	3-7	27
3-8	3-8	3-8	3-8	3-8	3-8	3-8	3-8	28
3-9	3-9	3-9	3-9	3-9	3-9	3-9	3-9	29
3-10	3-10	3-10	3-10	3-10	3-10	3-10	3-10	30
4-1	4-1	4-1	4-1	4-1	4-1	4-1	4-1	31
4-2	4-2	4-2	4-2	4-2	4-2	4-2	4-2	32
4-3	4-3	4-3	4-3	4-3	4-3	4-3	4-3	33
4-4	4-4	4-4	4-4	4-4	4-4	4-4	4-4	34
4-5	4-5	4-5	4-5	4-5	4-5	4-5	4-5	35
4-6	4-6	4-6	4-6	4-6	4-6	4-6	4-6	36
4-7	4-7	4-7	4-7	4-7	4-7	4-7	4-7	37
4-8	4-8	4-8	4-8	4-8	4-8	4-8	4-8	38
4-9	4-9	4-9	4-9	4-9	4-9	4-9	4-9	39
4-10	4-10	4-10	4-10	4-10	4-10	4-10	4-10	40
5-1	5-1	5-1	5-1	5-1	5-1	5-1	5-1	41
5-2	5-2	5-2	5-2	5-2	5-2	5-2	5-2	42
5-3	5-3	5-3	5-3	5-3	5-3	5-3	5-3	43
5-4	5-4	5-4	5-4	5-4	5-4	5-4	5-4	44
5-5	5-5	5-5	5-5	5-5	5-5	5-5	5-5	45
5-6	5-6	5-6	5-6	5-6	5-6	5-6	5-6	46
5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	47
5-8	5-8	5-8	5-8	5-8	5-8	5-8	5-8	48
5-9	5-9	5-9	5-9	5-9	5-9	5-9	5-9	49
5-10	5-10	5-10	5-10	5-10	5-10	5-10	5-10	50

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 m^2



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

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 m^2 area sub-plot.

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

R O A D

N ←

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

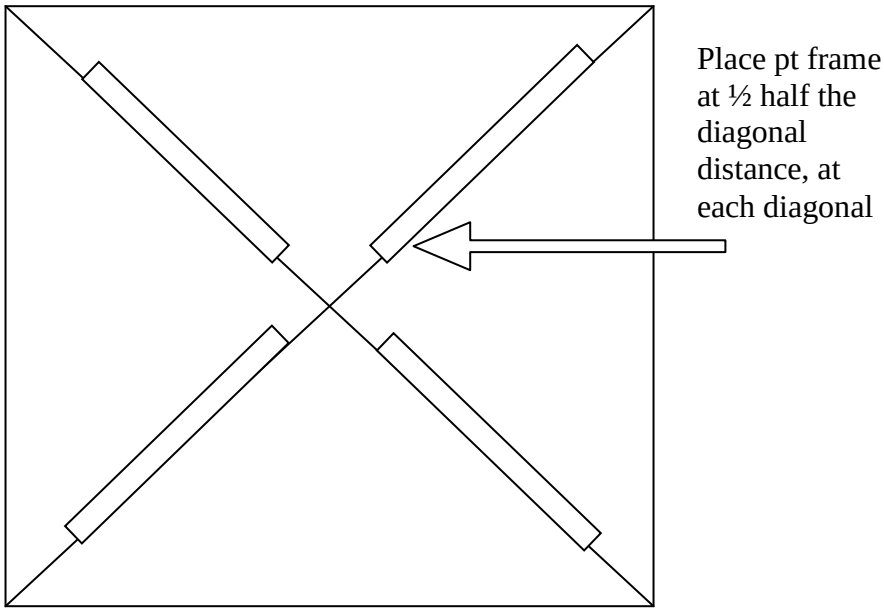
Density sampling (number of individuals of each species/m^2):

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 (m^2/m^2):

Use a 10 point frame to estimate cover in each 1 m^2 quadrat in which density was estimated. The point frame should be placed in 4 different locations, along each diagonal, as shown in the diagram, in each quadrat. Flip a coin to decide which direction the points should face. You may use the same directions for every diagonal in every quadrat. This will provide a total of 40 point contacts for each quadrat. The categories to records are plant species (use codes), litter, bare ground, and rocks. Be very critical about what the contact is. The accuracy of the methods is determined by how carefully contacts are made. Record only what the exact tip of the point touches at the soil surface. You may need to ignore a hit on a leaf to reach the soil surface. Do not penetrate the soil surface. All points must hit inside the quadrat.



Density and Point Frame Datasheet:

HUMUS EXPERIMENT DATA SHEET

Date_____ Recorder(s):_____

Block:_____(E or W) Treatment:_____(W, N, W+N, or C)
Transect:_____(1, 2, or 3) Plot: _____(1, 2, 3, 4, 5, or 6) Dig Image File:_____

Density Data: **Point of Intercept:**

Species (count)	# of Individuals		**Hit**	**Notes**
		1		
		2		
		3		
		4		
		5		
		6		
		7		
		8		
		9		
		10		
		11		
		12		
		13		
		14		
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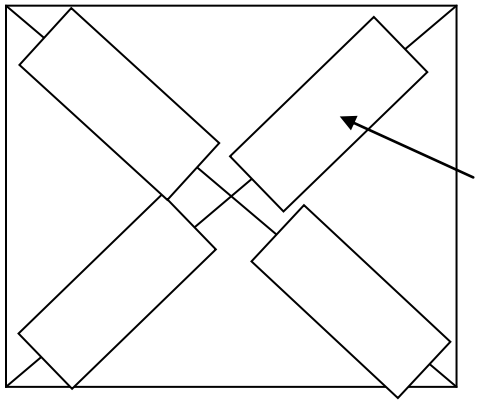
		38		
		39		
		40		

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

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



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

Canopy Cover Data Sheet:

Humus Experiment Canopy Cover	
Date:	Recorder:

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

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

Biomass Sampling (using digital photography) (g/m^2):

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 m^2 quadrat from a bird's eye view in the image. Record the image number on the datasheet for that plot. Record image numbers and memory cards number(s) that contain the images for this project in the orange digital camera log book. Label the memory card with Humus, Year, along with other project titles for which data are on that memory card.

QAQC Instructions:

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

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

Principal Investigator(s): Daniel Milchunas and Bill Lauenroth

Study Objectives: Monitor long-term above ground net primary production at sites with different soil textures and topographic positions.

What to know before you start sampling:

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

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

Experimental Design:

- 6 sites
- 3 transects at each site
- 5 plots on each transect
- Sample once per year at end of growing season
- Individual sample size is 0.25 m^2 circle frame with a 0.10 m^2 Daubenmire frame inside

Clipping Protocol:

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

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

BOBU= *Bouteloua gracilis*and *Buchloe dactyloides* combined
WSPG= Warm season perennial grass other than BOGR and BUDA (includes SPCR, ARLO, MUTO, DISP, etc)
CSPG= Cools season perennial graminoids (includes CAEL, PASM, SIHY, STCO, ORHY, etc)
CSAG= Cool season annual grass (includes VUOC, BRTE. etc)
FORB= All forbs
SS= Subshrubs (includes ARFR, EREF, CELA, etc ****Do Not Collect ATCA, CHNA, or YUGL****)
OSD= Old Standing Dead, previous years growth, grayish material

DO NOT CLIP ANY CACTUS or COLLECT LICHEN.

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

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
Functional Group CODE	FORB, SHRB, CSAG, CSPG, WSPG, BOBU, SD

QAQC Instructions:

IMPORTANT: In the field at the end of each site, gather all bags together and sort by transect. Then check that all plots are there for each transect, and they are labeled correctly and accounted for. ****Make sure there are bags for both quadrat sizes (0.10 m^2 & 0.25 m^2)****.This entails more than just counting that there are 5 plots for each of the 3 transects---are there two labeled the same? ---are all envelopes in the large bag labeled with the same site and transect-plot numbers? * **The check off sheet MUST be filled out.**

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

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

Sample Check Off and Delivery Instructions:

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

Grasses Acronym	Common Name	Scientific Name	Habit (P=Perennial, A=Annual, Bi=Biennial; Growth Form (G=Grass, F=Forb, SS=Sub Shrub)	(C=cool, W=Warm Season)	Functional Group Code (FORB, SS= sub-shrub, CSAG= cool season (CS) annual grass, CSPG = cool season (CS) perennial grass, WSPG=warm season (WS) perennial grass)
Agsm	western wheatgrass	Agropyron smithii	PG	CS	**CSPG**
Arlo	red threeawn	Aristida longiseta	PG	WS	**WSPG**
Bogr	blue grama	Bouteloua gracilis	PG	WS	**BOBU**
Brte	cheatgrass	Bromus tectorum	AG	CS	**CSAG**
Buda	Buffalograss	Buchloe dactyloides	PG	WS	**BOBU**
Cafi	threadleaf sedge	Carex filifolia	PG	CS	**CSPG**
Cael	needleleaf sedge	Carex eleocharis	PG	CS	**CSPG**
Disp	inland saltgrass	Distichlis spicata	PG	WS	**WSPG**
Muto	ring muhly	Muhlenbergia torreyi	PG	WS	**WSPG**
Orhy	Indian ricegrass	Oryzopsis hymenoides	PG	CS	**CSPG**
Sihy	bottlebrush squirreltail	Sitanion hystrix	PG	CS	**CSPG**
Spai	alkali sacaton	Sporobolus airoides	PG	WS	**WSPG**
Spcr	sand dropseed	Sporobolus cryptandrus	PG	WS	**WSPG**
Stco	needle and thread	Stipa comata	PG	CS	**CSPG**
Vuoc	sixweeks fescue	Vulpia octoflora	AG	CS	**CSAG**
Forbs and Shrubs (Full shrubs are not clipped)					
Arfr	fringed sagewort	Artimisia frigida	PSS	CS	**SS**
Asbi	two-grooved milkvetch	Astragalus bisulcatus	PF	CS	**FORB**
Cela	common winter fat	Ceratoides lanata	PSS	CS	**SS**
Chin	ragleaf goosefoot	Chenopodium incanum	AF	WS	**FORB**
Chle	narrowleaf goosefoot (lambsquarters)	Chenopodium leptophyllum	AF	WS	**FORB**
Chvi	hairy goldenaster	Chrysopsis villosa	PF	WS	**FORB**
Chna	rubber rabbitbrush	Chrysothamnus nauseosus	PS	WS	**Full shrub**
Ciun	wavyleaf thistle	Cirsium undulatum	PF	WS	**FORB**
Clse	Rocky Mountain beeplant	Cleome serrulata	AF	WS	**FORB**

Coum	common bastard toadflax	Comandra umbellata	PF	CS	**FORB**
Coar**	field bindweed	Convolvulus arvensis	PF	WS	**FORB**
Covi	purple mammilaria (pincushion cactus)	Coryphantha vivipara	PSS	CAM	**SS**
Crmi	plains cryptantha	Cryptantha minima	AF	CS	**FORB**
Cyac	stemless spring parsley	Cymopterus acaulis	PF	CS	**FORB**
Cymo	mountain spring parsley	Cymopterus montanus	PF	CS	**FORB**
Dege	Geyer (plains) larkspur	Delphinium geyeri	PF	CS	**FORB**
Depi	pinnata tansymustard	Descurania pinnata	AF	CS	**FORB**
Dypa	prairie dogweed (fetid marigold)	Dyssodia papposa	AF	WS	**FORB**
Ecvi*	hedgehog cactus	Echinocereus viridiflorus	PS	CAM	**N/A**
Eref	speading wildbuckwheat	Eriogonum effusum	PSS	CS	**SS**
Evnu	Nuttal's evolvulus	Evolvulus nuttallianus	PF	WS	**FORB**
Gaco	scarlet gaura	Gaura coccinea	PF	CS	**FORB**
Grsq	curlycup gumweed	Grindelia squarrosa	PF or BiF	WS	**FORB**
Gusa	broom snakeweed	Gutierrezia sarothrae	PSS	CS	**SS**
Hasp	ironplant tansyaster	Haplopappus spinulosus	PF	WS	**FORB**
Hepe	prairie sunflower	Helianthus petiolaris	PF	WS	**FORB**
Ipla	looseflowered gilia	Ipompsis laxiflora	AF to BiF	WS	**FORB**
Kosc	Iran summer cyperus	Kochia scoparia	AF	WS	**FORB**
Lare	blueburr stickseed	Lappula redowskii	AF	CS	**FORB**
Lede	prairie pepperweed	Lepidium densiflorum	AF or BiF	CS	**FORB**
Lemo	common starlily or mountain lily	Leucocrinum montanum	PF	CS	**FORB**
Lipu	dotted gayfeather	Liatris punctata	PF	WS	**FORB**
Liin	narrowleaf gromwell	Lithosperma incisum	PF	CS	**FORB**
Lupu	rusty lupine	Lupinus pusillus	AF	CS	**FORB**
Lyju	rush skeletonweed	Lygodesmia juncea	PF	WS	**FORB**
Mata	tansyleaf aster	Machaeranthera tanacetifolia	AF	WS	**FORB**
Meof	yellow sweetclover	Melilotus officinalis	AF or BiF	WS	**FORB**
Mili	linearleaved four-o'clock	Mirabilis linearis	PF	WS	**FORB**
Oeal	prairie evening primrose	Oenothera albicaulis	AF	WS	**FORB**
Oppo	plains prickly pear	Opuntia polyacantha	PS	CAM	**N/A**
Oxla	lambert loco (crazyweed)	Oxytropis lambertii	PF	CS	**FORB**
Oxse	silky loco	Oxytropis sericea	PF	CS	**FORB**
PAME	foliose lichen	Pamelias sp.	LICHEN		**N/A**

Peal	white penstemon	Penstemon albidus	PF	CS	**FORB**
Pean	narrowleaved penstemon	Penstemon angustifolius	PF	CS	**FORB**
Piop	plains bahia	Picradeniopsis oppositifolia	PF	WS	**FORB**
Plpa	woolly plantain (Indianwheat)	Plantago patagonica	AF	CS	**FORB**
Pool*	common purslane	Portulaca oleracea	AF	WS	**FORB**
Pste	slimflower scurfpea (wild alfalfa)	Psoralea tenuiflora	PF	WS	**FORB**
Raco	prairie coneflower	Ratibida columnifera	PF	WS	**FORB**
Ruve	veiny dock	Rumex venosus	PF	CS	**FORB**
Saib	Russianthistle	Salsola iberica	AF	WS	**FORB**
Scbr	Britton's skullcap	Scutellaria brittonii	PF	WS	**FORB**
Setr	prairie groundsel	Senecio tridenticulatus	PF	CS	**FORB**
Sial	tumbling hedgemustard	Sisymbrium altissimum	AF	CS	**FORB**
Sonu	silky sophora	Sophora nuttalliana	PF	WS	**FORB**
Spco	scarlet globemallow	Sphaeralcea coccinea	PF	CS	**FORB**
Tapa	prairie fameflower	Talinum parviflorum	PF	WS	**FORB**
Taof	common dandelion	Taraxacum officinale	PF	CS	**FORB**
Thfi	threadleaf greenthread	Thelesperma filifolium	PF	CS	**FORB**
Thme	rayless greenthread	Thelesperma megapotamicum	PF	CS	**FORB**
Togr	largeflower townsendia	Townsendia grandiflora	PF	CS	**FORB**
Troc	prairie sipderwort	Tradescantia occidenalis	PF	CS	**FORB**
Vebr	bigbract verbena	Verbena bracteata	PF	WS	**FORB**
Yugl	small soapweed	Yucca glauca	PSS	CS	**Full shrub**

Check-off Sheet:

Ridge 0.10 m^2	Ridge 0.25 m^2	Mid-slope 0.10 m^2	Mid-slope 0.25 m^2	Swale 0.10 m^2	Swale 0.25 m^2	Sec 25 0.10 m^2	Sec 25 0.25 m^2	Owl Creek 0.10 m^2	Owl Creek 0.25 m^2	ESA 0.10 m^2	ESA 0.25 m^2
T-1, P-1	T-1, P-1	T-1, P-1	T-1, P-1	T-1, P-1	T-1, P-1	T-1, P-1	T-1, P-1	T-1, P-1	T-1, P-1	T-1, P-1	T-1, P-1
T-1, P-2	T-1, P-2	T-1, P-2	T-1, P-2	T-1, P-2	T-1, P-2	T-1, P-2	T-1, P-2	T-1, P-2	T-1, P-2	T-1, P-2	T-1, P-2
T-1, P-3	T-1, P-3	T-1, P-3	T-1, P-3	T-1, P-3	T-1, P-3	T-1, P-3	T-1, P-3	T-1, P-3	T-1, P-3	T-1, P-3	T-1, P-3
T-1, P-4	T-1, P-4	T-1, P-4	T-1, P-4	T-1, P-4	T-1, P-4	T-1, P-4	T-1, P-4	T-1, P-4	T-1, P-4	T-1, P-4	T-1, P-4
T-1, P-5	T-1, P-5	T-1, P-5	T-1, P-5	T-1, P-5	T-1, P-5	T-1, P-5	T-1, P-5	T-1, P-5	T-1, P-5	T-1, P-5	T-1, P-5
T-2, P-1	T-2, P-1	T-2, P-1	T-2, P-1	T-2, P-1	T-2, P-1	T-2, P-1	T-2, P-1	T-2, P-1	T-2, P-1	T-2, P-1	T-2, P-1
T-2, P-2	T-2, P-2	T-2, P-2	T-2, P-2	T-2, P-2	T-2, P-2	T-2, P-2	T-2, P-2	T-2, P-2	T-2, P-2	T-2, P-2	T-2, P-2
T-2, P-3	T-2, P-3	T-2, P-3	T-2, P-3	T-2, P-3	T-2, P-3	T-2, P-3	T-2, P-3	T-2, P-3	T-2, P-3	T-2, P-3	T-2, P-3
T-2, P-4	T-2, P-4	T-2, P-4	T-2, P-4	T-2, P-4	T-2, P-4	T-2, P-4	T-2, P-4	T-2, P-4	T-2, P-4	T-2, P-4	T-2, P-4
T-2, P-5	T-2, P-5	T-2, P-5	T-2, P-5	T-2, P-5	T-2, P-5	T-2, P-5	T-2, P-5	T-2, P-5	T-2, P-5	T-2, P-5	T-2, P-5
T-3, P-1	T-3, P-1	T-3, P-1	T-3, P-1	T-3, P-1	T-3, P-1	T-3, P-1	T-3, P-1	T-3, P-1	T-3, P-1	T-3, P-1	T-3, P-1
T-3, P-2	T-3, P-2	T-3, P-2	T-3, P-2	T-3, P-2	T-3, P-2	T-3, P-2	T-3, P-2	T-3, P-2	T-3, P-2	T-3, P-2	T-3, P-2
T-3, P-3	T-3, P-3	T-3, P-3	T-3, P-3	T-3, P-3	T-3, P-3	T-3, P-3	T-3, P-3	T-3, P-3	T-3, P-3	T-3, P-3	T-3, P-3
T-3, P-4	T-3, P-4	T-3, P-4	T-3, P-4	T-3, P-4	T-3, P-4	T-3, P-4	T-3, P-4	T-3, P-4	T-3, P-4	T-3, P-4	T-3, P-4
T-3, P-5	T-3, P-5	T-3, P-5	T-3, P-5	T-3, P-5	T-3, P-5	T-3, P-5	T-3, P-5	T-3, P-5	T-3, P-5	T-3, P-5	T-3, P-5

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 Photo for Chart plots is taken first then they 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, 5W and 5E *(5a was changed to 5W and 5b to 5E in 2009).*

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 $1m^2$

Equipment:

ladder	knee pads (1 kneeling, 2 knee)	extra leads	water
flash card	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 Chart/OPPO flash card and orange log book, and a step ladder to hover over the plot. Check the camera settings to be sure images are of the maximum resolution the camera is capable of collecting. 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. The flash card with images must be downloaded to the SGS central server when the prject sampling is complete and an email sent to WLauenro@uwyo.edu indicating the images are available.

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.

Using toothpicks break the plot up into manageable pieces, this will be easier to keep track of what you have done and what is left. You can use big chunks of BOGR to help guide you. 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 paper. When tracing the plant, pull back the vegetation so that only the point where the plant contacts the ground is recorded. After you have traced the vegetation you may put a toothpick in the center to help keep track of what you have done. 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 (single tiller species of grass, CAHE, AGSM, etc..) 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 strongly contrasting color to those on the map and a symbol other than a circle (square, triangle, etc..) to represent that species. If you encounter multiple species and run out of symbols, start to use an X in the center of the symbols. Make sure not to use the same color for repeating symbols. Example: If you have a red square and run out of symbols, you should (using a contrasting color) make a blue square with an X in the middle. When recording you can still do individual dots (as it would be a waste of time to stop and mark an X every time), just make sure to go back and draw in the X along with the symbol. **Add all new symbols and species (with 4 letter code) to the map legend. This should be clear so that anyone can read it, as the maps are digitized back in the lab.** If a species only occurs once in the plot draw a line from the plant to the edge of the paper (off the plot) and mark it with 4 letter code. Remember not to 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 B'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 than bogr or whether there was a lot of litter.
- If oppo exists on a chart 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.
-PASM 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.
- CAEL – 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

ARS #32 Grazing and Soil Texture (GZTX)
Principal Investigator(s): Dan Milchunas
Study Objectives: To evaluate the plant community species composition, and aboveground net primary production (ANPP) in response to long-term grazing by cattle.

What to know before you start sampling:

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

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

Experimental Design for Basal and Canopy Cover (*revised to drop density and add canopy cover in 2009):*

- 6 sites
- 3 sites with 4 treatments, 3 sites with 5 treatments
- 20 plots per each treatment at each site with 4 treatments, 35 plots per each 4 treatments at each site with 5 treatments.
- Plot are measured once per year, mid-season
- Individual plots are .1 m^2

Experimental Design for Clipping:

- 6 sites (24, 11, 19, 7, 5W, and 5E)
- 3 sites with 4 treatments (24, 19, 11), 3 sites with 5 treatments (7, 5W and 5E)
- Site 24 & 11
  - 6 NPP plots in UU
  - 6 NPP plots in GU
  - 6 NPP plots under cages and 6 utilized plots adjacent to cages in GG (12 total plots)
  - 6 NPP plots under cages and 6 utilized plots adjacent to cages in UG (12 total plots)

- Site 19
  - 6 NPP plots in UU
  - 6 NPP plots in GU
  - 6 NPP plots under cages and 6 utilized plots adjacent to cages in UG (12 total plots)
  - 10 NPP plots under cages and 6 utilized plots adjacent to cages in GG (16 total plots)

- Site 7, 5W, and 5E
    - 6 NPP plots in the UU
    - 6 NPP plots under cages and 6 utilized plots adjacent to cages in the UG (12 total plots)
    - 10 NPP plots in RU
    - 10 NPP plots in GU
    - 10 NPP plots under cages and 10 utilized plots adjacent to cages in GG (20 total plots)
- Plots are sampled once per year at the end of the growing season
- Individual plots are 0.25 m^2

Basal and Canopy Cover Protocol:

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

Randomly flagging each treatment:

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

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

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

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

The canopy cover may be less or more than 100% as much of the plot may be litter or bare ground or the canopy may be layered and each species overhanging in the plot must be recorded. Basal cover should

theoretically add to 100%, but because you are doing classes and not actual percentages the midpoint of the classes will only approximately add to 100%.

Root Ingrowth Donut Procedure:

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

There are two (2) root ingrowth donuts at each treatment within each site. Only the GZGZ and UNUN treatments are sampled and only five of the six sites (5 west, 5 east, 7, 11, 24 – 19 is not sampled for roots). Therefore, there are 5 sites X 2 treatments X 2 locations = 20 donuts. There are two depths sampled at this study (0-10 and 10-40cm), except that two of the donuts are not beveled and the 0-10cm depth must be cut without the PVC guide (bring a ruler with cm to measure this).

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

Bag label example:

GZTX donuts
Date (mo/day/yr)
Site (5 west, 5 east, 7, 11, 24)
Treatment (GZGZ or UNUN)
Plot (plot 1 or plot 2)
Depth (0-10 or 10-40)
Bag number (1 of 2or3.., 2 of 2or3, ….

QAQC Instructions for cover:

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

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

Example Data Sheet:

Exclosure Study
Date: Collected By:

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

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

2010 Random Coordinates and Check-off Sheet (please use following pages):

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

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

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

7 U/G Plots	Check Off	7 G/G Plots	Check Off	7 G/U Plots	Check Off	7 U/U Plots	Check Off	7 RU Plots	Check Off
1		1		1C		1C		1C	
2		2		2C		2C		2C	
3		3		3C		3C		3C	
4		4		4C		4C		4C	
5		5		5C		5C		5C	
6		6		6C		6C		6C	
7		7		7C		7		7C	
8		8		8C		8		8C	
9		9		9C		9		9C	
10		10		10C		10		10C	
11		11		11		11		11	
12		12		12		12		12	
13		13		13		13		13	
14		14		14		14		14	
15		15		15		15		15	
16		16		16		16		16	
17		17		17		17		17	
18		18		18		18		18	
19		19		19		19		19	
20		20		20		20		20	
21		21		21		21		21	
22		22		22		22		22	
23		23		23		23		23	
24		24		24		24		24	
25		25		25		25		25	
26		26		26		26		26	
27		27		27		27		27	
28		28		28		28		28	
29		29		29		29		29	
30		30		30		30		30	
31		31		31		31		31	
32		32		32		32		32	
33		33		33		33		33	
34		34		34		34		34	
35		35		35		35		35	
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Notes:								37	
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								44	
								45	

5W U/G Plots	Check Off	5W G/G Plots	Check Off	5W G/U Plots	Check Off	5W U/U Plots	Check Off	5W RU Plots	Check Off
1		1		1C		1C		1C	
2		2		2C		2C		2C	
3		3		3C		3C		3C	
4		4		4C		4C		4C	
5		5		5C		5C		5C	
6		6		6C		6C		6C	
7		7		7C		7		7C	
8		8		8C		8		8C	
9		9		9C		9		9C	
10		10		10C		10		10C	
11		11		11		11		11	
12		12		12		12		12	
13		13		13		13		13	
14		14		14		14		14	
15		15		15		15		15	
16		16		16		16		16	
17		17		17		17		17	
18		18		18		18		18	
19		19		19		19		19	
20		20		20		20		20	
21		21		21		21		21	
22		22		22		22		22	
23		23		23		23		23	
24		24		24		24		24	
25		25		25		25		25	
26		26		26		26		26	
27		27		27		27		27	
28		28		28		28		28	
29		29		29		29		29	
30		30		30		30		30	
31		31		31		31		31	
32		32		32		32		32	
33		33		33		33		33	
34		34		34		34		34	
35		35		35		35		35	
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								40	
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								42	
								43	
								44	
								45	

5E U/G Plots	Check Off	5E G/G Plots	Check Off	5E G/U Plots	Check Off	5E U/U Plots	Check Off	5E RU Plots	Check Off
1		1		1C		1C		1C	
2		2		2C		2C		2C	
3		3		3C		3C		3C	
4		4		4C		4C		4C	
5		5		5C		5C		5C	
6		6		6C		6C		6C	
7		7		7C		7		7C	
8		8		8C		8		8C	
9		9		9C		9		9C	
10		10		10C		10		10C	
11		11		11		11		11	
12		12		12		12		12	
13		13		13		13		13	
14		14		14		14		14	
15		15		15		15		15	
16		16		16		16		16	
17		17		17		17		17	
18		18		18		18		18	
19		19		19		19		19	
20		20		20		20		20	
21		21		21		21		21	
22		22		22		22		22	
23		23		23		23		23	
24		24		24		24		24	
25		25		25		25		25	
26		26		26		26		26	
27		27		27		27		27	
28		28		28		28		28	
29		29		29		29		29	
30		30		30		30		30	
31		31		31		31		31	
32		32		32		32		32	
33		33		33		33		33	
34		34		34		34		34	
35		35		35		35		35	
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GZTX Clipping Protocol:

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

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

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

Function group classifications for ANPP:

BOBU= *Bouteloua gracilis*and *Buchloe dactyloides* combined
WSPG= Warm season perennial grass other than BOGR and BUDA (includes SPCR, ARLO, MUTO and DISP)
CSPG= Cools season perennial graminoids (includes CAEL, PASM, SIHY, STCO and ORHY)
CSAG= Cool season annual grass (includes VUOC and BRTE)
FORB= All forbs
SS= Subshrubs (includes ARFR, EREF, CELA ****Do Not Collect ATCA, CHNA, YUGL****)
OSD= Old Standing Dead, previous year’s growth

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

Example Label:

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

QAQC Instructions:

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

2010 Field Season GZTX Clipped NPP and Util plots
Exclosure 24

24 U/G	Check Off	Util (3m to E)	24 G/G	Check Off	Util (3m to E)
1C			1C		
2C			2C		
3C			3C		
4C			4C		
5C			5C		
6C			6C		
24 U/U			**24 G/U**		
1C		N/A	1C		N/A
2C		N/A	2C		N/A
3C		N/A	3C		N/A
4C		N/A	4C		N/A
5C		N/A	5C		N/A
6C		N/A	6C		N/A

Exclosure 11

11 U/G	Check Off	Util (3m to E)	11 G/G	Check Off	Util (3m to E)
1C			1C		
2C			2C		
3C			3C		
4C			4C		
5C			5C		
6C			6C		
11 U/U			**11 G/U**		
1C		N/A	1C		N/A
2C		N/A	2C		N/A
3C		N/A	3C		N/A
4C		N/A	4C		N/A
5C		N/A	5C		N/A
6C		N/A	6C		N/A

2010 Field Season GZTX Clipped NPP and Util plots

Exclosure 19

19 U/G	**Check Off**	**Util (3m to E)**	**19 G/G**	**Check Off**	**Util (3m to E)**
1C			1C		
2C			2C		
3C			3C		
4C			4C		
5C			5C		
6C			6C		
			7C		N/A
			8C		N/A
			9C		N/A
			10C		N/A
19 U/U			**19 G/U**		
1C		N/A	1C		N/A
2C		N/A	2C		N/A
3C		N/A	3C		N/A
4C		N/A	4C		N/A
5C		N/A	5C		N/A
6C		N/A	6C		N/A

2010 Field Season GZTX Clipped NPP and Util plots

Exclosure 7

7 U/G	Check Off	Util (3m to E)	7 G/G	Check Off	Util (3m to E)
1C			1C		
2C			2C		
3C			3C		
4C			4C		
5C			5C		
6C			6C		
			7C		
			8C		
			9C		
			10C		
7 U/U			**7 G/U**		
1C		N/A	1C		N/A
2C		N/A	2C		N/A
3C		N/A	3C		N/A
4C		N/A	4C		N/A
5C		N/A	5C		N/A
6C		N/A	6C		N/A
			7C		N/A
			8C		N/A
			9C		N/A
			10C		N/A
7 RU					
1C		N/A			
2C		N/A			
3C		N/A			
4C		N/A			
5C		N/A			
6C		N/A			
7C		N/A			
8C		N/A			
9C		N/A			
10C		N/A			

2010 Field Season GZTX Clipped NPP and Util plots

Exclosure 5W

5W U/G	Check Off	Util (3m to E)	5W G/G	Check Off	Util (3m to E)
1C			1C		
2C			2C		
3C			3C		
4C			4C		
5C			5C		
6C			6C		
			7C		
			8C		
			9C		
			10C		
5W U/U			**5W G/U**		
1C		N/A	1C		N/A
2C		N/A	2C		N/A
3C		N/A	3C		N/A
4C		N/A	4C		N/A
5C		N/A	5C		N/A
6C		N/A	6C		N/A
			7C		N/A
			8C		N/A
			9C		N/A
			10C		N/A
5W RU					
1C		N/A			
2C		N/A			
3C		N/A			
4C		N/A			
5C		N/A			
6C		N/A			
7C		N/A			
8C		N/A			
9C		N/A			
10C		N/A			

2010 Field Season GZTX Clipped NPP and Util plots
Exclosure 5E

5E U/G	Check Off	Util (3m to E)	5E G/G	Check Off	Util (3m to E)
1C			1C		
2C			2C		
3C			3C		
4C			4C		
5C			5C		
6C			6C		
			7C		
			8C		
			9C		
			10C		
5E U/U			**5E G/U**		
1C		N/A	1C		N/A
2C		N/A	2C		N/A
3C		N/A	3C		N/A
4C		N/A	4C		N/A
5C		N/A	5C		N/A
6C		N/A	6C		N/A
			7C		N/A
			8C		N/A
			9C		N/A
			10C		N/A
5E RU					
1C		N/A			
2C		N/A			
3C		N/A			
4C		N/A			
5C		N/A			
6C		N/A			
7C		N/A			
8C		N/A			
9C		N/A			
10C		N/A			

Delivery Instructions:

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

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

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

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

OPPO Sampling on GZTX Sites:
Principal Investigator: Dan Milchunas

Things to know before starting:
- How to identify a "new year cladode"
- Where to measure on the cladode to obtain the "width", "length", and "height".
- All six sites are sampled, but only the GZGZ and UNUN treatments.
- Use a $1m^2$ quadrat frame.
- Measurements of cladode size are in mm.
- For cladodes that are clipped, wet weights MUST be obtained as fast as possible, before moisture is lost.

OPPO sampling will occur alongside the GZTX clipping.

New Cladode Measurements:
- Randomly locate a lot location for the site-treatment you are at..
- Look to see if there are any new OPPO cladodes within the frame. If not randomly locate another meter frame location (and call (write on data sheet) this the 2^{nd} meter-quadrat).
- If new OPPO cladodes are found within the frame measure the width, length, and height of all new cladodes with calipers (mm). Make sure to write down which treatment (GZGZ or UNUN and site (see maps and locations listed above) you are in, what meter you are at (1m, 2m, 3m, ……), width (mm) of cladode, date, recorders.
- You only have to sample/measure 10 new cladodes, but you have to sample at least 3 different quadrats. Note, it may take many more than three random locations to get 10 new cladodes. (Ex: if one quadrat has 12 new cladodes then you still have to sample 2 more quadrats, no matter how many cladodes per quadrat). Or if there are no new cladodes found after 5 quadrats have been placed, then you still need to at least obtain 3 more that total at least 10 new cladodes. It is alright to sample more than 10 cladodes, this is the minimum. **You must keep on writing which quadrat number you are sampling, including any zero-cladode quadrats.** For example, if you have placed 11 quadrats and still not obtained 3 that sum to 10 new cladodes then you would write 12 as your next qudrat number.

Clipping OPPO:
- Find middle of treatment.
- Randomly throw out 10 flags numbered 1-10.
- Locate the closest new cladode and clip it at the junction with older cladode (Note- avoid but record if any seedling new cladodes are encountered. These are new cladodes that stand on their own and are not attached to an older large cladode).
- Put each clipped cladode (do not cut yet for drying) in a seperate bag and label:
  - GZTX OPPO
  - Date
  - GZGZ or UNUN
  - Pad # (1-10)
- Put all clipped OPPO bags in to one larger one to take back to lab.
- When back in lab weigh all OPPO cladodes for a wet-weight. **This must be done as soon as possible, before moisture is lost from the cladodes.**
  - Write weight on sample bag as Wet-Wt (ex: Wet-Wt-2.25g)
  - After weighing cut into the pad into many small pieces (1/2 inch approx, or at least 3 pieces for small ones) for drying and place back into sample bag.
  - Put pads into dryer at 55˚C until dry, ~14 days.
  - Pull pads out of drying oven and weigh a second time.
  - Put pads back into dryer at 55°C, for another ~7-10 days.
  - Pull pads out of oven and weigh a third time. If weight has not changed then the pads are dry, but if pads are still losing weight then put back in the drying oven for a few more days (repeat process until all pads are dry- Meaning they are no longer losing any weight when dry).
- Keep all samples after weighing, by delivering to the sample prep lab on campus.

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 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

(21)

Mileage	Species	Age	No.	Topogr	Hab

(21)

Species codes: CALA coyote; VUVE swift fox

Age: VO very old; OL old; VF *very* fresh; 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 April, July, October, and January (if enough volunteers can be found for winter sampling) during the period of the new moon (between last and first quarter-moons).

2. Start at dark at the cattle guard at the fence line road near the driveway to site manager's house in 21SE.

3. Three observers in back of truck, two with spotlights. The spotlights should sweep out from the road to a 45 degree angle as you drive along. The third observer watches for rabbits and measures the distance of animals from the road with the range finder. The driver or another observer watches for rabbits, especially in the road at the 0 distance and records data.

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

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

SPECIES:

SYAU	desert cottontails (Sylvilagus audubonii)
LECA	black-tailed jackrabbits (Lepus californicus)
LETO	white-tailed jackrabbits (Lepus townsendii)

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			

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

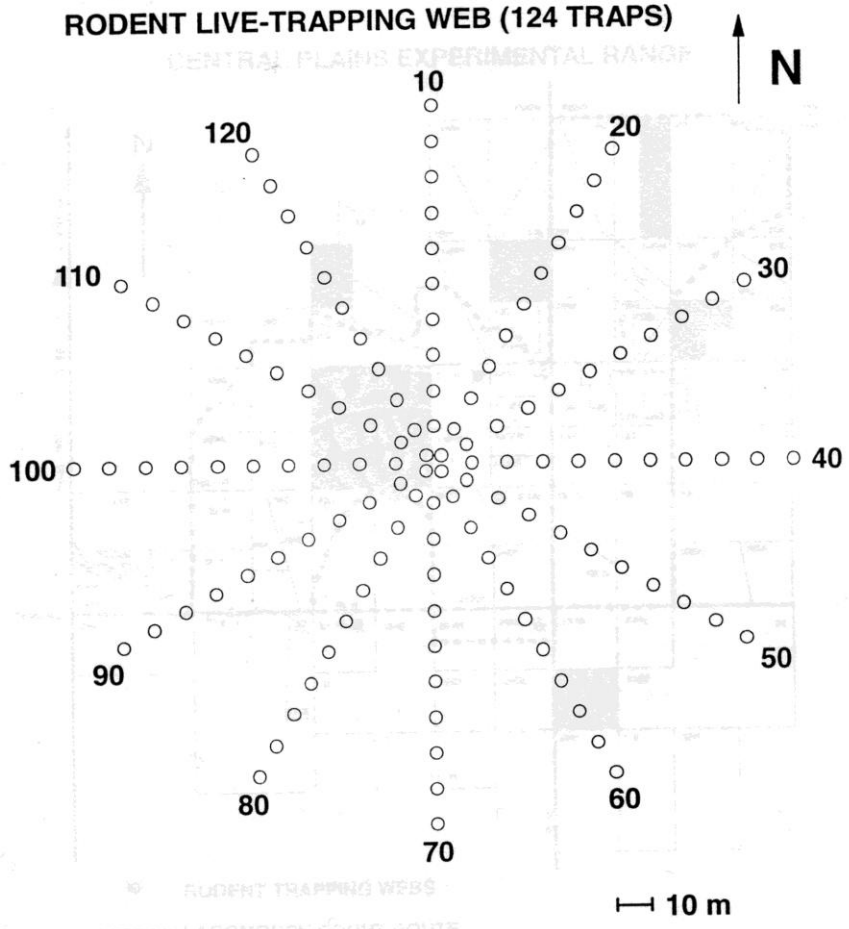
Principal Investigator(s): Paul Stapp

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 and possibly 2009 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, 27NE, and 31E), and three batch burn sites (26NWSE, 26NESE, and 30NWSE). 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 Protocol:

EQUIPMENT: 190 Sherman large live traps, peanut butter/oats balls in wax paper (ca. 500), loose peanut butter/oats mixture, wool, (3) each of blue/green Sharpies marking pens, data sheets, 3 pesola scales (100-300g each), (3) 6" rulers, (2) boxes of 1-ga Ziploc bags, 3-4 technicians (depending on experience), a pair of dikes, pencils.

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

1. Each web trapped for four consecutive days in late-May and in late-July (**Burns are only trapped in 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.

Data Sheet:
P. Stapp, 4/98

Page ___ of ___

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

DATE _____WEB _____DAY _____ #SPRUNG _____ COLOR _____

FIELD CREW _____CLOUD _____PRECIP _____ TEMP _____

Trap#	Capt (O,N,R)	Species	Age (A,S,J)	Sex (M,F)	Repr (R,N)	Weight (0.5 g)	Comments

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 26NWSE, 26NESE and 30NWSE in May, June, July, August *maybe later if grasshoppers are still abundant*.***

Experimental Design:

- 6 sites (31E replaced 26NW in 2007)
- 4 transects at each site
- 5 plots (or hoops for grasshopper) at each transect
- Sampled once per month (May - August) during the 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, and August.
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.

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 released. Bring any unknown specimens back to lab for identification.

Grasshopper density:

Each site will have **60 mini-hoops** placed along **three 200-m web line transects** (20 per transect). The transects will run from trapping stations 20-80, 40-100, and 60-120. Place the hoops within 1-2 m of each trap station on the three chosen web lines, being careful to not place them in the travel paths (skip the web center). If necessary, use a landscaping stake to anchor the hoop.

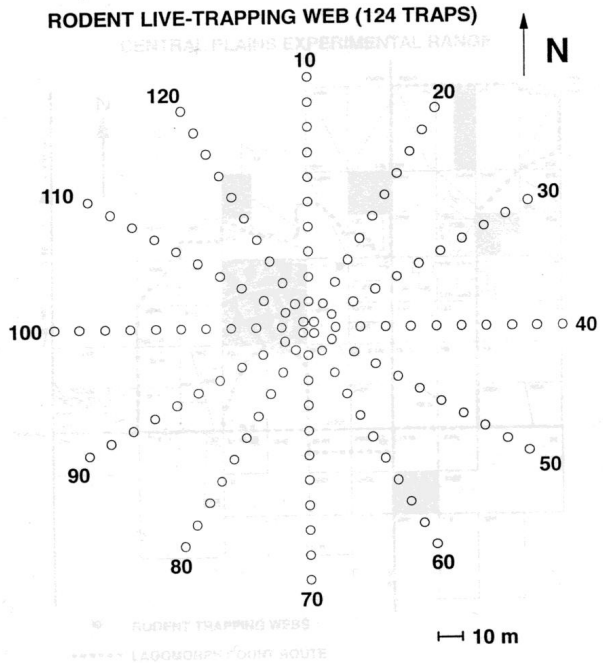
After 3-4 days (after initial hoop placement), return to the web to sample grasshoppers in the hoops. Approach each hoop carefully, being sure not to flush any grasshoppers from the hoop before you arrive. Use a 1-2 m pole to flush any grasshoppers from the hoop and record the number flushed on the data sheet. 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. Move to the next hoop and repeat. Do not sample on rainy days or days with very high winds, and do not shade the hoops when you approach.

Community sampling:

After finishing hoop counts, conduct **200 sweeps** with a butterfly net (trying to get at least 30-40 grasshoppers per web, even if it takes over 200 sweeps), walking at a normal pace on a part of the web that does not overlap where you have already sampled. At the end of the sweeps on a given site, collect all the grasshoppers and place them in a 1-ga ziploc. Insert a piece of paper labeled with the site and date. Put the bags from all the sites in the freezer to euthanize the grasshoppers. Later, divide the individuals from one bag into different morphospecies and use the SGS specimen collection to identify. For any morphospecies that cannot be identified, pin out 1-2 specimens and label with the site, date and species code, e.g. UNK A. Be sure to tally the number of individuals of each species, including any UNKNOWNS and by developmental stage if possible, so that we can calculate the proportional representation of each species in the total sample. Take the unknowns to CSU Entomology for identification.

Dry the hoppers for 1-2 days at 40 C and weigh them to obtain total grasshopper biomass for each site and sampling date.

SGS Grasshopper Sampling



Instructions: There are 60 hoops along 3 transects (20 each) that run between the number 20-80, 40-100, and 60-120 trapping stations on the web (please see diagram). Each hoop will be 1 meter to the right or left of the trapping station. 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. Be sure to record date, time, recorders, temp (C), wind, and cloud cover (%). Community sampling will be done after grasshopper hoops. 200 sweeps at a normal pace (collect around 30-40 grasshoppers per web, even if it is over 200 sweeps). Put all grasshoppers in ziploc bag with piece of paper inside labeled with date and location. *Please use this datasheet at small mammal trapping webs: three shrubland sites (13NW, 13SW, and 24NE) three upland grassland sites (25NE, 27NE, and 31E) and patch burns 26, 25 and 31.*

Date _____ **Site** _____

Recorders _____ **Time (military)** _____

Temperature (C) _____ **Wind** _____ **Cloud cover (%)** _____

Hoop Counts (write number flushed per transect):

Transect	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
1																					
2																					
3																					
TOTAL																					

Community Analysis (count the number of each species in the ziploc bag; give unknowns a label and make vouchers to be identified later):

Species/ Developmental stage (adult, nymph)	Number	% of Total
TOTAL		

Total DRY weight (g) of all grasshoppers in sample _____

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 where checked, animals released, and traps closed before you leave the site.

Data Sheet:

P. Stapp, 4/98

SGS-LTER Long-Term Monitoring Project
Arthropod Abundance on Trapping Webs

WEB CODE: _____
DATE/TIME OPENED: _____ DATE/TIME CLOSED: _____
OBSERVERS: _____
CURRENT WEATHER: _____
GENERAL WEATHER DURING SESSION: _____

Trap	No. In Hoop	Empty	Tenebrionidae (list by Spp)	Carabidae	Other beetles (list Family)	Orthoptera	Hemiptera	Spiders	Other
A1									
A2									
A3									
A4									
A5									
B1									
B2									
B3									
B4									
B5									
C1									
C2									
C3									
C4									
C5									
D1									
D2									
D3									
D4									
D5									

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, 27NE, 31E). Each web must be recorded with the section number and quarter-section direction on the data sheet.

Experimental Design:
- 6 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 .10m^2

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 father 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.

Data Sheet:

Web _____, p. ____ of ____

SGS-LTER Monitoring Project
Vegetation on Small Mammal Webs

Date Surveyed _____ Surveyed / Recorded by _____

Year	Web	Transect Point (1-3)	(1-10)	Species	% Cover	(cm) Height grass	forb	shrub	# shrubs w/in 1m small	# shrubs w/in 3m ATCA	# mounds w/ in 3m ant	# mounds w/ in 3m gopher	# bur > 3 cm w/ in 3m	Distance (m) to nearest w/in 30 m Ant Mnd	Gopher Mnd	ATCA	ATCA dim. (cm) L	W	H	Mound dim. (cm) Ant L	W	Gopher L	W

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.

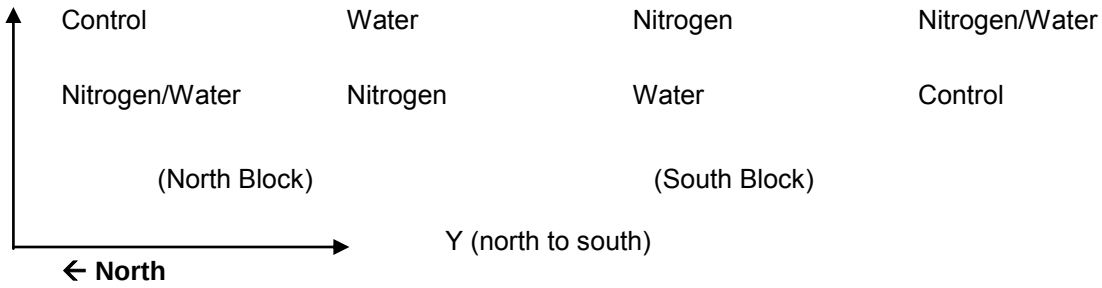
What to know before you start sampling

- ✓ ***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 m^2



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 if 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:
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

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

2010 Random Density and Cover Coordinates and Check-off Sheet:

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

ARS #155 BOGR Removal Experiment *(revised 4/12/07 and for site 5 codes in 2009)*
Principal Investigator(s): Bill Lauenroth
Study Objectives: to characterize important species in the Shortgrass Steppe plant community.

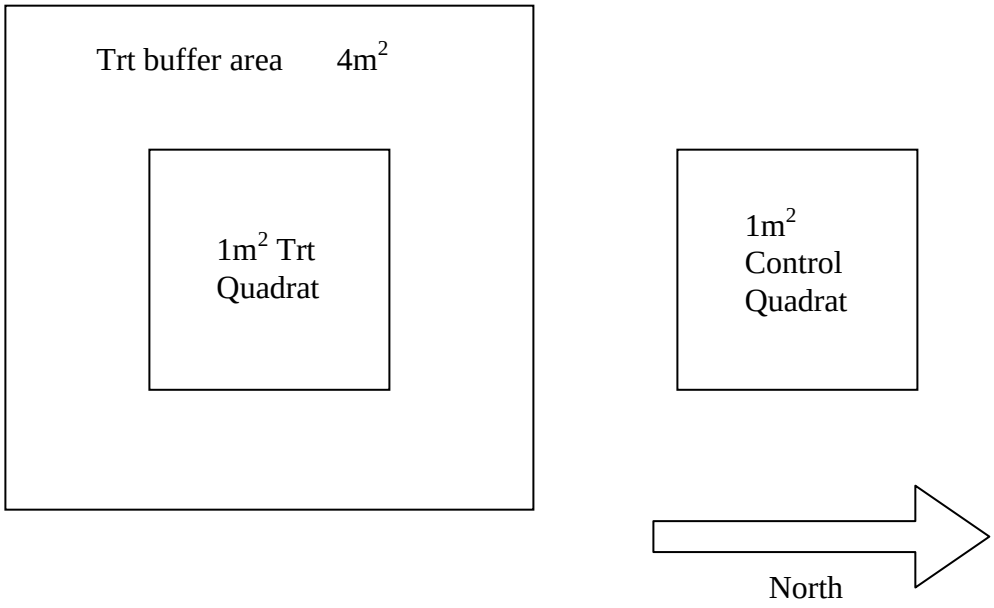
What to know before you start sampling

- ✓ ***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) Exclosures Sites (5W, 5E, 7, 11, 19, 24): 2 sets of treatment/control plots inside the Grazed/Ungrazed exclosure and 2 sets of treatment/control plots outside the GU exclosure. 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 1m^2 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 m^2



Density and Cover Sampling Protocols

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

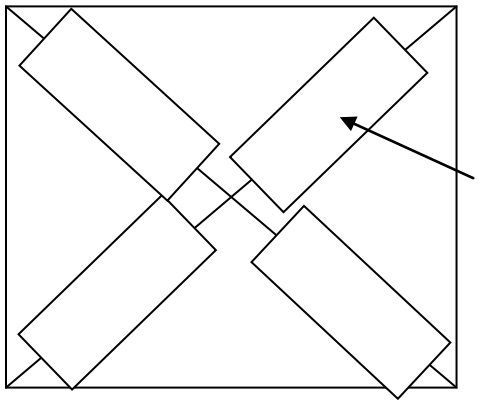
Methods: First, measure plant species density in the 1 m^2 quadrats by counting the number of individuals of each species. Sod-forming grasses such as Bogr and Buda (most likely in the control plots) should be counted as individuals when there is no connection by rhizomes or stolons present. Use you 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 VUOC, PASM 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 m^2 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 exclosure.

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

Canopy Cover Sampling (Daubenmire cover classes, note added 2009):

Locate each of 4 quadrats centered on a diagonal of the 1 m^2 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 (T,1, 2, 3, 4, 5, or 6) for each group of species.



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

Canopy Cover Data Sheet:

BOGR Removal Experiment Canopy Cover	
Date:	Recorder:

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

Section	Inside/Outside G/U Exclosure	East/West Plot Location	Treatment/Control	Daub Quadrat # (1-4)	Species	Canopy Class Code (1-6)

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 (density and point-frame): 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		
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		36		
		37		
		38		
		39		
		40		

ARS# 156 RAINOUT SHELTER (revised 2010)

Principal Investigator(s): Indy Burke

Study Objectives: To determine the effect of drought on ecosystem functioning in the shortgrass steppe.

What to know before you start sampling

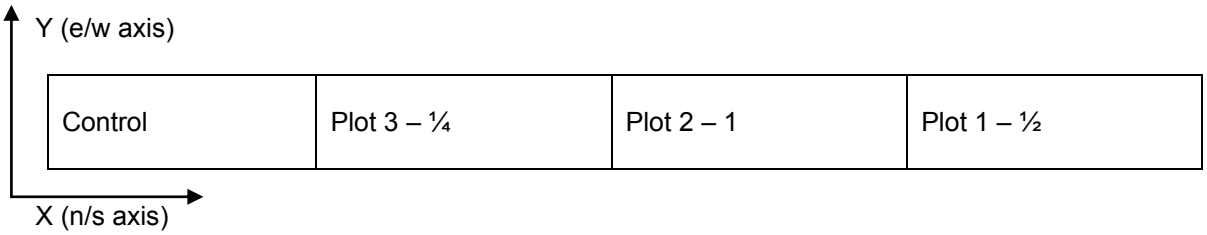
- ***Are you familiar with study location and control and treatment plots***
- ***Have you been instructed on how to collect, manage and apply data from the tipping rain bucket data logger? Have you checked that the PPT data compares to the rain stick data collected by Mark at the Standard Meteorological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

Study Area Locations: The rain out shelters are located to the east of the SGS-LTER Headquarters. Four plots are located at each shelter. The treatment plots are between the rails, get covered by the roof when it rains and get watered each Tuesday (**WATERING STOPPED Field Season 2010**). The control plots are to the north each shelter. This diagram illustrates the design as if you are standing with your back to the SGS-LTER office buildings.

The block to the northeast is called NORTH and the block to the southwest is called SOUTH. The coordinate grid in each sampling plot runs along the east-west flashing and north-south rails.

Experimental Design:

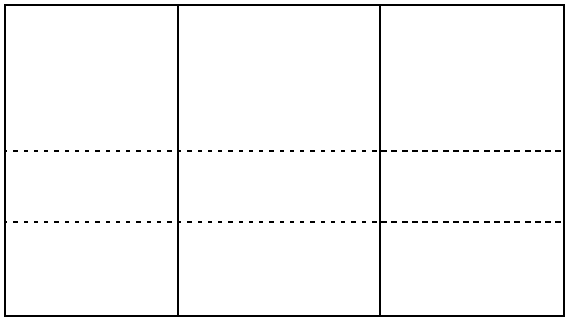
- 2 blocks
- 4 treatments per block
- 5 quadrats per treatment
- Quadrats are sampled once per year, late season
- Individual Quadrats are ¼ m^2



Plot Level Design:

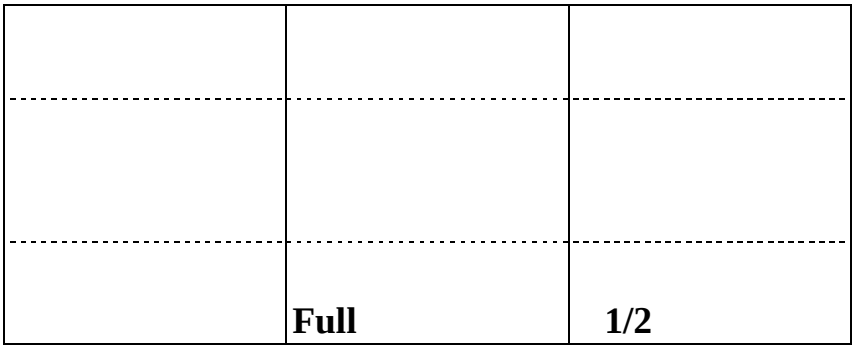
Mark's house

NE- rain out



Full **1/4** **1/2**

SW-rain out



Maintenance:

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 09 + SOUTH 09 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: T=Trace (<1%),1 = 1-5%; 2 = 5-14%; 3 = 15-24%; 4 = 25-39%, 5 = 40-59%, 6 = 60-100%. Record the Daubenmire cover class (T,1, 2, 3, 4, 5, or 6) number on the data sheet.

2010 Rainout Random Coordinates for Use in Each Density and Basal Cover Plot

Quadrant	X	Y
1	.7	.8
2	1.3	2.3
3	0.9	1.5
4	3.1	3.3
5	1.9	1.1

Data Sheet:

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

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

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

Principal Investigator: Bill Lauenroth and Justin Derner

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

What to know before you start sampling

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

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

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

Site codes and treatments are as follows:

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

Experimental Design:

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

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

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

Sampling Protocol:

Items Needed:

Daubenmire Rectangles

Reference plant list with species codes

Procedures:

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

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

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

We identify only one Astragalus/Oxytropis to species—the vine like one is ASGR (with thinner leaves and small purple flowers). All others are lumped under the code ASOX. The two 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. Individuals may not be rooted in the frame, as their canopy may be hanging over the sampling area.

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

QAQC Instructions

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

Data Sheet:

Study:____ARS #200 Plover Grazing Study_____

Sampling Date:_____ Collected by:_____

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

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

ARS#200 Vegetation Structure for Small Animals on Plover Grazing Pastures
Principal Investigator(s): Paul Stapp
Study Objectives: to detect differences between years in vegetation percent cover and vegetation height and structure in plover-grazing pastures.

What to know before you start sampling:
- ✓ ***You can identify plants to species***
- ✓ ***You are familiar with the sampling methodologies***
- ✓ ***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.

ARS #243 Fire Ecology Studies – Patch Study

Principal Investigator(s): Justin Derner

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

What to know before you start sampling:

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

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

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

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

Basal Cover Protocol:

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

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

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

We identify only one Astragalus/Oxytropis to species—the vine like one is ASGR (with thinner leaves and small purple flowers). All others are lumped under the code ASOX. The two 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: T=< 1%, 1=1-5, 2=6-15, 3=16-25, 4=26-40
5=41-60, 6=>60

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

Data Sheet:

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

Sampling Date:_____Collected by:_____

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

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

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

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

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

CAN OTHER PEOPLE UNDERSTAND YOUR WRITING???

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

Example Label:

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

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

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

What to know before you start sampling

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

Study Area Locations and Design: Treatments include frequency of fire (0, 1 and 3 years), and season of burn (spring or fall). There 4 reps of each combination of burning frequency and season. In section 15nw, 20, 20X20 m plots, each subdivided into 4, 10X10 m quadrants numbered 1, 2, 3, and 4. Quadrant 1 is located in the NW corner of each plot and is for biomass, Quadrant 2 in the NE corner and is for soil respiration, trace gas, soil sampling, soil water, soil temperature, etc,, Quadrant 3 in the SW corner and is for cactus, and Quadrant 4 in the SE corner is sampled for Daubenmire basal and canopy cover classes.
Basal Cover Protocol: Cover will be sampled in early August. Sample 25, 0.1m2 plots within Quadrant 4area for each treatment quadrat, plots are randomly located (600 quadrats). Unknowns should be labeled as forb, grass or shrub with the codes UNFB, UNGR, or UNSH. If an unknown is encountered several times it should be given a number or name, and identified at a later date, **and the data sheets recoded with the correct four-letter species code.**

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

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

We identify only one Astragalus/Oxytropis to species—the vine like one is ASGR (with thinner leaves and small purple flowers). All others are lumped under the code ASOX. The two 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: T=<1, 1=1-5, 2=6-15, 3=16-25, 4=26-40
5=41-60, 6=>60

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

Data Sheet:

Study:_ ARS #243 Fire Ecology Plot Study: Cover of Vegetation

Sampling Date:_____ Collected by:_____

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

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

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

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

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

CAN OTHER PEOPLE UNDERSTAND YOUR WRITING???

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Example Label:

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

NutNet

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

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

What you should know before you start sampling:

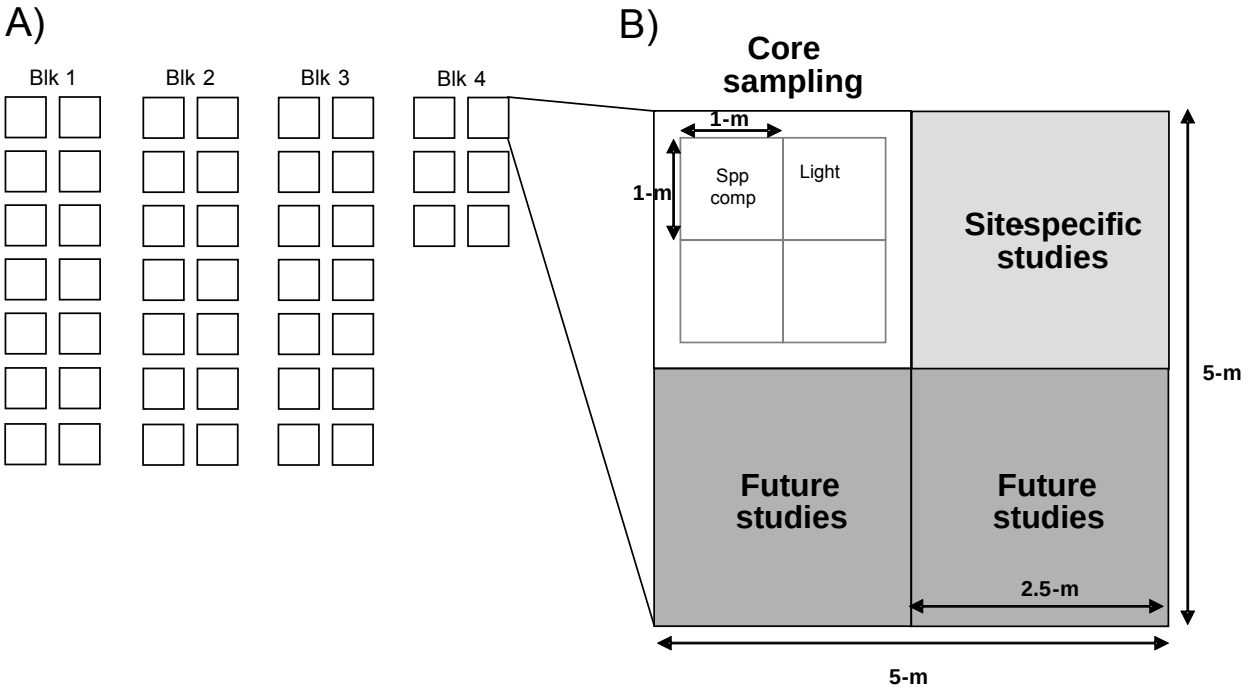
- Double check plot locations prior to applying nutrients.
- Not all plots are sampled. Non-sampled plots are randomized with sampled plots.

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

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

Each 5 x 5m plot is divided into four 2.5 x 2.5m subplots, with one randomly located subplot dedicated to the core sampling. The core subplot is then further divided into 4 1 x 1m sub-sub plots. The middle of the core subplot is marked by an orange plastic stake. The 1-m^2 sub-sub plot in the same position as the "Core" subplot (denoted on the site diagrams) within the larger plot is used for biomass harvesting, while the 1-m^2 sub-sub plot in the same position as the "Site" subplot within the larger plot is used for species composition and light availability measurements. A plot layout scheme is attached to the end of this protocol.

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



Nutrient Additions

Time of year: close to May 1

Equipment needed: Pails for mixing nutrients, rubber gloves

Nutrient Addition protocol: Lay nutrient bags out on appropriate plots according site map prior to application. At each plot, thoroughly mix the different nutrients within each bag. Spread nutrients evenly over each plot by hand. Starting at the top of each plot, spread approximately ¼ of the nutrients over the entire plot, in 5, 1m wide rows. Turn 90 degrees, and repeat starting on the side of each plot. Continue until all nutrients are used.

Herbivore Exclosures

Time of year: close to May 1

Equipment needed: Fence stretcher, metal bar, Zip ties

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

Species Composition Sampling
Time of year: at peak biomass
Equipment Needed: 1m^2 frame, data sheets, pen/pencil
Species Composition sampling protocol:
Within each Core subplot, a permanent, 1-m^2 sub-sub plot has been established in which species composition and light availability data are collected. This sub-sub plot is in the same position as the “site” subplot within the larger plot. A 1-m^2 metal frame is used for the species composition estimates. The frame should be aligned using the center point of the “Core” subplot, as denoted by an orange plastic stake, and the diagonal corners of the 1-m^2 sub-subplots, as denoted by orange-tipped roofing nails.

Aerial cover is estimated for each plant species separately using a modified Daubenmire method, in which cover is estimated to the nearest 1% percent for each species rooted within the plot (cardboard cutouts can be used to facilitate estimation). Percent cover is also estimated for woody overstory, litter, bare soil, and rocks. Material is considered to be litter- and not the current year’s mortality- if it is grey in color and clearly not the current year’s growth

Date	Block:		Observer		Format= Plot/subplot				
Species	**Plot_____**	**Plot____**	**Plot____**	**Plot____**	**Plot____**	**Plot____**	**Plot____**	**Plot____**	**Plot____**
Litter									
Bare Ground									
Rock									
BOGR									
CAEL									
PASM									
STCO									
KOCR									
VUOC									
ARFR									
SPCO									
CHVI									

Light Measurement Sampling

Time of year: when species composition sampling occurs; cloudless day as close to solar noon as possible (i.e., 11 am to 2 pm).

Equipment Needed: 1-m length Decagon Ceptometer, data sheets, pencil/pen

Light Measurement sampling protocol:

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

Date Block: Observer			
Plot	Below 1	Below 2	Above 1

Biomass Harvesting

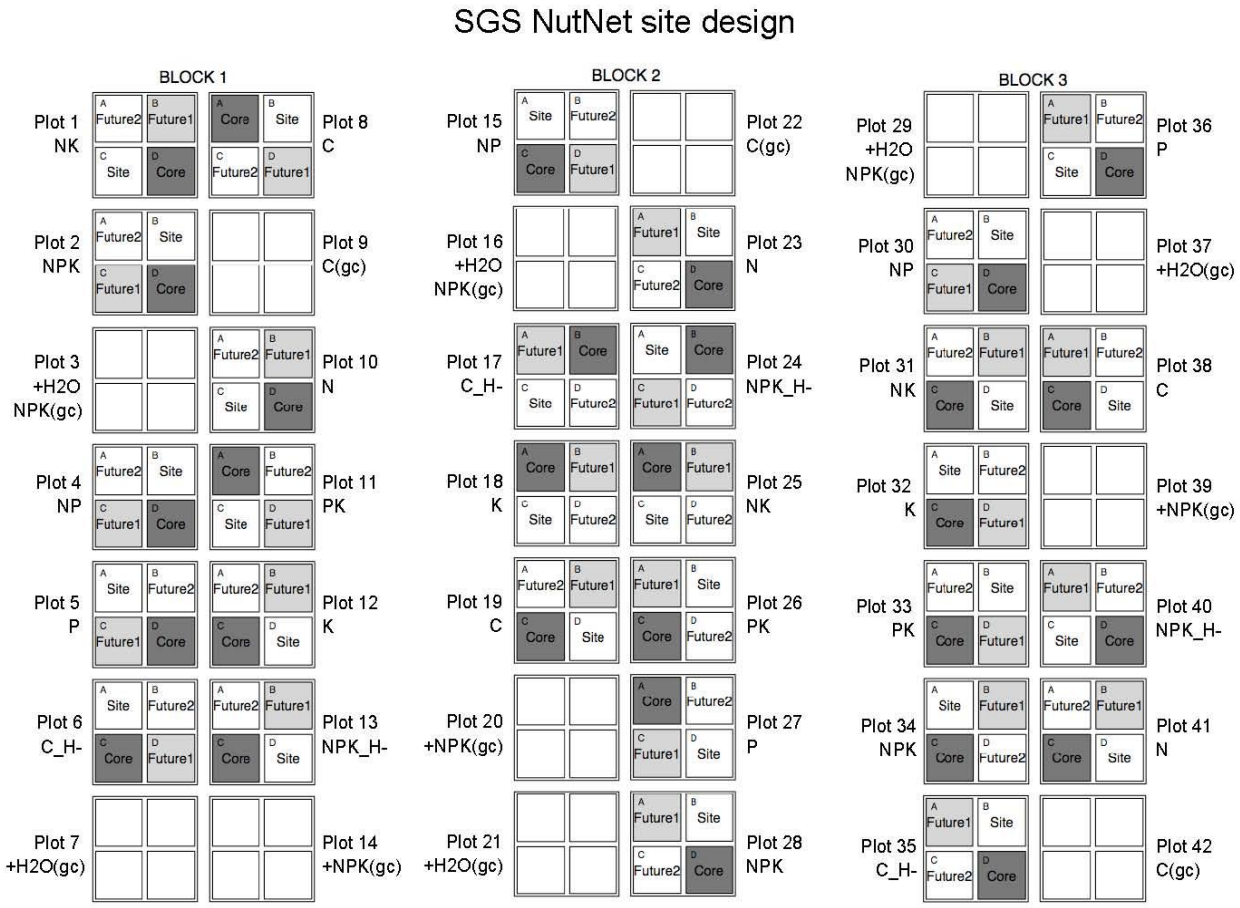
Time of year: at peak biomass

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

Biomass harvesting protocol:

Align the 1 x 1m^2 frame using the center point of the "Core" subplot, as indicated by a plastic stake, and the diagonal corners of the 1-m^2 sub-subplots, as indicated by orange-tipped roofing nails. The 1-m^2 frame should be oriented East to West.

Two 0.10-m by 1.0-m strips within the 1-m^2 subplot are harvested, with the same two strips within the frame harvested for all "Core" plots. Harvesting is conducted by clipping the graminoid just above the crown, and clipping the forb or subshrub just above the soil surface, or at the junction of the current and previous year's growth. Lichens are also collected and bagged. The SGS research site includes several species of Cactaceae, which are measured either for diameter and height or number of cladodes per plant prior to harvesting. Harvested biomass is bagged separately for each strip within the 1-m^2 subplot. Throughout harvesting, plant litter that is unattached and on the ground is not collected. Plants are considered to occur within the sampling area only if the plant is rooted within the area.



Grazing of CRP
Principal Investigator: Dan Milchunas and Mark Vandever

The primary objective of this study is to assess grazing effects on both recently planted and mid-seral CRP, here referred to as "new" and "old" fields respectively (planted in 2003 or 1989).

Tasks:
Daubenmire canopy and basal cover (NOT by classes), ANPP (total only), utilization (visual caged vs uncaged), and root production and biomass (ingrowth donut method and coring).

Dan will do the cover estimates, but if for some reason that is not possible do not proceed unless you have been instructed on the two differences from other studies in the way Daubenmire cover estimates are to be made. This means a visual demonstration of how crowns are classified as cover.

Experimental design:
There are ungrazed, heavily grazed, and lightly grazed pastures within each old and new CRP field, and a mowed treatment associated with the new CRP field (Fig. X map). The areas marked "grazed" in the map below are the heavy grazed treatments, and the new field lightly grazed treatment is to the west (left) and the old field lightly grazed treatment is to the south. Native shortgrass is the furthest east, but we will use GZTX as a reference site so there is currently no sampling there. There are six replicate plots for each treatment. Replicates run from north being 1 to south being 6 in each treatment. It is extremely important that replicates (as well as treatments) are correctly identified and recorded in all sampling. Note that in the new field, all treatments, the replicates alternate previously wheat and then sorghum plantings, as you can see by the different plant species running in strips. If you are walking from one replicate to the next in the "new" field, and the vegetation is the same as the last replicate, then you must have missed (jumped over) a replicate.

Canopy and Basal Cover:
Twenty (20) Daubenmire quadrats are sampled at each treatment-replicate plot. Locations for starting are randomly chosen at one quadrat of the plot, and then paced whereby 10 quadrats are in the east half and 10 in the west half of each plot. Quadrats are placed in front of where the toe randomly hits after pacing a set number of paces between each quadrat location, with the number of paces determined by the individual's pace size and the need to distribute the 20 locations throughout the plot. Only ant mounds or other large disturbances are avoided.

Both canopy cover and then basal cover are estimated at the same 20 locations in each treatment rep. DO NOT USE Daubenmire classes. Instead, estimate by 1% increments up to 10% and then by 5% increments above 10%. DO NOT estimate crown cover as litter or bare if there is live crown underneath litter or bare ground perched on top of the live crown of grasses (note – this is different from what you may have done for other studies). For both of the above underlined, do not proceed unless you understand the former, and have been instructed in the latter. Estimate all species first, doing canopy of species-1 and then basal of species-1 (by subtracting out the canopy part), species 2 … etc., then the smaller of bare or litter basal, then the larger of either bare or litter as 'all the rest' for basal cover. In this manner, you focus on each species only once, but do both canopy then basal (note – this means you Do Not do all canopy and then do all basal estimates for the quadrat). In this manner, all basal hits will add to 100 since the largest of BAREground or LITTer are the remainder. Check you estimates of the remainder every 5-10 quadrats by asking the recorder to tell you what the remainder was, after you independently estimated it visually.

FILL OUT CHECKOFF SHEET to be SURE that ALL QUADRATS have been sampled for every field-age, grazing-mowing treatment, and replicate.

ANPP clipping:
See utilization procedure below before clipping under any cage and do that first.

There are two (2) quadrats per plot at each treatment-replicate, one located randomly just outside and along the north of the plot and one outside along the south. Clip just above crown height as for all other studies. Clip only 1) total live-plus-recent-dead (not by species or groups) labeled "ANPP and 2) total old standing dead labeled "OSD", doing a rough field sort of these two groups. Thus, you will have 2 bags/quadrat, (or if there is no old standing dead you can write "no OSD" on the ANPP bag. Quadrat size is 30 cm by 100 cm – note that this is NOT the quarter-meter circular quadrats you may have used in other studies.

OPPO is not clipped, LICH is not collected, and ATCA, CHNA, and YUGL are not clipped.

FILL OUT CHECKOFF SHEET to be SURE that ALL QUADRATS have been sampled for every field-age, grazing-mowing treatment, and replicate.

Dry at 55°C, checking that oven temperature is accurate by using a lab thermometer.

Cages are moved to new random location in late March/early April, since we try to get cattle on when cheatgrass, KOSC, etc. are palatable.

SEE bag label example below in next section.

Utilization:

The amount removed by cattle is estimated in all grazed treatments. At each ANPP cage, before clipping under the cage, visually estimate the difference between the mass amount of all standing vegetation under the cage compared to outside the cage. Outside the cage means about a meter away from the cage in all directions around it. Tilt the cage off to one side to get an unobstructed view of the ungrazed vegetation. Write on the ANPP live-plus-recent-dead bag BOTH the % removed and the % residual. In other words, if there is 25 % less vegetation mass outside the cage compared with inside the cage (there is 75% outside if the inside is considered 100%), then write "25% util – 75% resid" meaning that cattle ate 25% at that location. Write both utilization and residual %'s so that it cannot be misunderstood which estimate you mean. If there appears to be less vegetation under the cage than outside, then write "cage X[whatever number] % greater" on the ANPP bag that you will now clip from under the cage. Estimates are by 5% increments.

Bag labeling example –write one of what is in parentheses):

Study (CRP)
Date (Month-day-year)
Field (new or old)
Treatment (Ungrazed, Light, or Heavy [there are no mowed for clipping])
Quadrat number (1 or 2)
Sample type (ANPP or OSD) and if more than one bag write 1 of 2, 2 of 2, etc
Consumption (X % UTIL) **and (**Y% RESID)

Root Ingrowth:

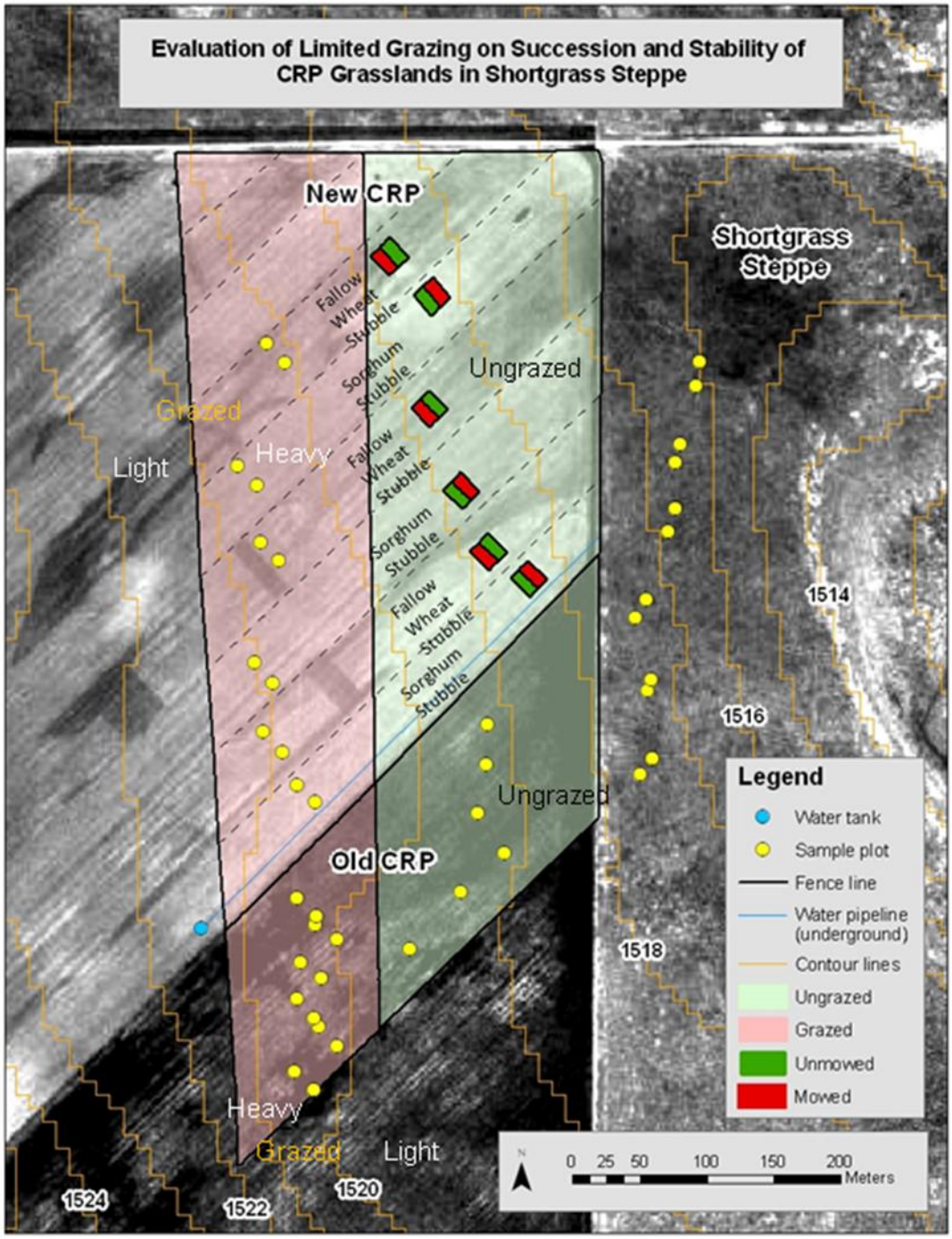
See instructions for this under GZTX. At this study site, only the ungrazed and heavily grazed treatments are sampled, in both the new and old fields. Also note that there are only replicates 2-6 sampled for root ingrowth, except for the New CRP field, where all six reps are done. There are two (2) donuts (cylinders) per plot, one to the north and one to the south. Remember to write 1 of 2, 2 of 2, etc on the bags, because there will usually be multiple bags. Do not over-fill bags where they break, especially if soil is moist.

Root Biomass:

This is sampled only every three (3) years. Take two (2) cores to 40cm deep, randomly, one north and one south of ANPP sample line for each plot. Cores are the large 66.5mm inside diameter. Remove litter and crown material before coring. For each core, take a sample from 0-20cm, remove and bag, then take another sample from 20-40cm.

FILL OUT CHECKOFF SHEET to be SURE that ALL QUADRATS have been sampled for every field-age, grazing-mowing treatment,replicate, and quadrat.

Dry at 55°C, checking that oven temperature is accurate by using a lab thermometer.


Evaluation of Limited Grazing on Succession and Stability of CRP Grasslands in Shortgrass Steppe
New CRP
Shortgrass Steppe
Fallow
Wheat
Stubble
Sorghum
Stubble
Ungrazed
Grazed
Light
Heavy
1514
1516
Ungrazed
Old CRP
1518
Heavy
Grazed
Light
1524
1522
1520
Legend
Water tank
Sample plot
Fence line
Water pipeline (underground)
Contour lines
Ungrazed
Grazed
Unmowed
Mowed
N
0 25 50 100 150 200
Meters

Root Ingrowth Donuts (for both GZTX and CRP studies)
Principal Investigators: Milchunas, Brown, Vandever

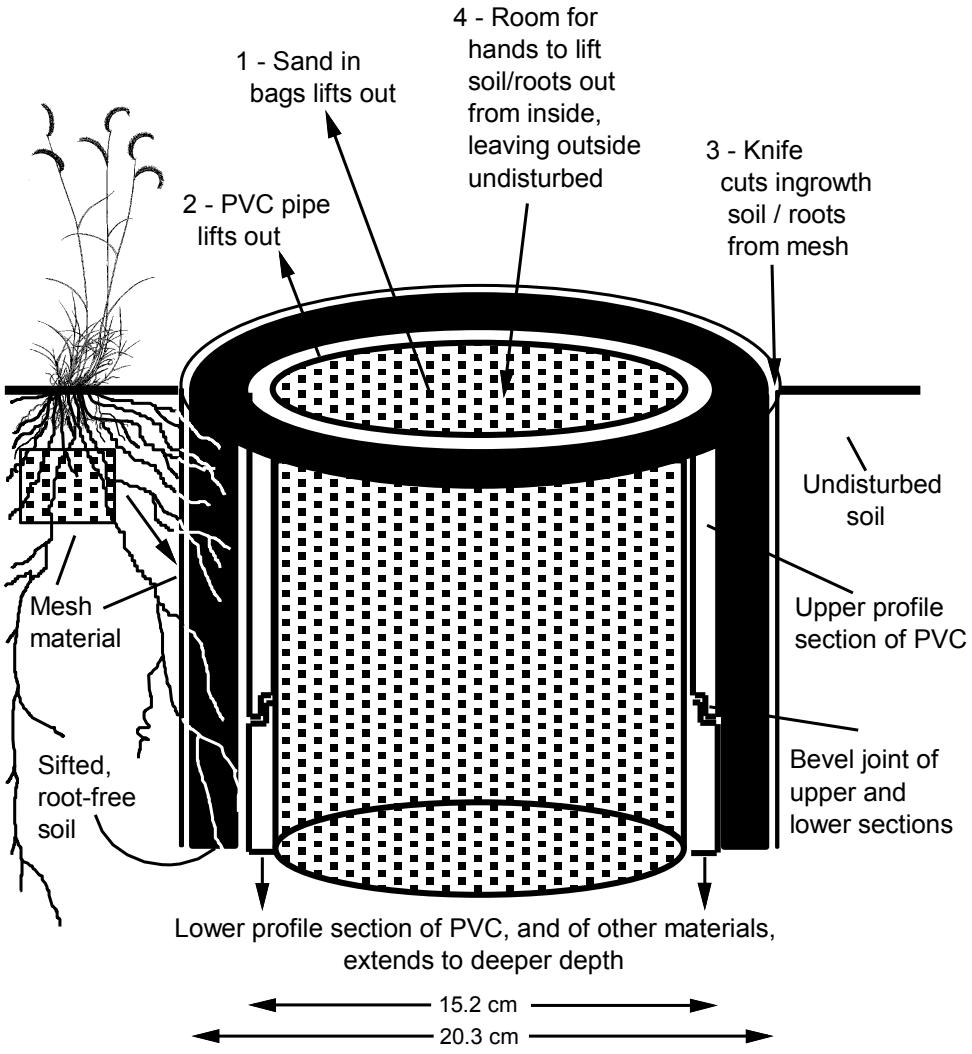
Separate instructions concerning the experimental design (numbers of in each treatment) for ingrowth donuts are in each of the "GZTX" and "Grazing of CRP" protocols. Covered here are instructions for sampling each donut cylinder in either study.

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

Milchunas, D. G., A. R. Mosier, J. A. Morgan, D. LeCain, J. Y. King, and J. A. Nelson. 2005. Root production and tissue quality in a shortgrass steppe exposed to elevated CO_2: Using a new ingrowth method. Plant and Soil 268:111-122.

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

A quick view picture of the method is:



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

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

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

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

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

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

Place bags in oven at 55^{o}C until dry so roots do not decompose.

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

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