Experimental Design to Measure Off-Take and Monitor Range Condition Trends Using Small Exclosures

Eric Cole, December 1999

The National Elk Refuge supports elk and bison populations from November-April each year. Elk numbers have exceeded the 7,500 objective in most years since 1986, and bison numbers are increasing at approximately 20 percent per year. There is anecdotal evidence that high ungulate density is negatively affecting grassland condition, but our current vegetation sampling program is not designed to evaluate this trend. The following study will evaluate range condition trends in non-cultivated grasslands using ungulate exclosures.

I hypothesize that range quality indicators will decline in non-exclosed areas over time, and that the decline will be greatest in areas in close proximity to feedgrounds. Since an exclosure will be paired with each non-exclosed sampling site, we will be able to accurately measure ungulate utilization of forage, and compare range condition in areas with ungulate impact (non-exclosed areas) to controls with no ungulate impact (exclosures). I hypothesize that range quality indicators will improve over time in exclosures, and that the difference in range quality between exclosed and non-exclosed areas will increase over time. I further hypothesize that this difference will be greatest in areas in close proximity to feedgrounds.

Specific variables measured: 1)Ungulate manure accumulation by species, 2)Forage utilized, 3)water infiltration, 4)plant rooting depth, 5)Daubenmeir cover estimates by species and bare ground.

Specific null hypotheses to be tested:
1)Manure accumulation is not higher in non-exclosed areas compared to exclosed areas.
2)Manure accumulation does not decrease in non-exclosed areas with increasing distance from feedgrounds.
3)Forage Utilized does not decrease with increasing distance from feedgrounds.
4)Water infiltration rate is not higher in exclosed areas compared to non-exclosed areas.
5) Water infiltration does not increase in non-exclosed areas with increasing distance from feedgrounds.
6)Plant rooting depth is not higher in exclosed areas compared to non-exclosed areas.
7) Plant rooting depth does not increase in non-exclosed areas with increasing distance from feedgrounds.
8)% bare ground is not higher in non-exclosed areas compared to exclosed areas.
9)% bare ground does not decrease in non-exclosed areas with increasing distance from feedgrounds.

SITE LOCATIONS: Suggest six sites in each ecological type. At each site a paired exclosure and unexclosed site. Suggest a paired t-test for analysis of each variable and

then use distance from feedground to explain difference between exclosed and unexclosed using regression. SEE MAP FOR RANDOMLY SELECTED LOCATIONS.

Randomly Selected Wet Meadow Study Sites:
W1: Polygon 16 sub-irrigated poa, section 27NE
W2: Polygon 100 sub-irrigated poa, section 15NE
W3: Polygon 124 sub-irrigated poa, section 13NE
W4: Polygon 120 carex/juncus, section 18NW
W5: Polygon 125 sub-irrigated poa, section 12NE
W6: Polygon 172 carex/juncus, section 36SW

Randomly Selected Dry Meadow Sites:
D1: Polygon 94 Ag/Poa Miller Butte, section 23 NE
D2: Polygon 136 Ag/Stipa East Refuge Slope, section 8SE
D3: Polygon 169 Ag/Stipa East Refuge Slope, section 4SE
D4: Polygon 187 Ag/Stipa Slopes near McBride, section 32SE
D5: Polygon 244 Ag/Stipa Slopes near McBride, section 31NE
D6: Polygon 20 Ag/Stipa Slopes east of shop, section 26NW

Randomly Selected Alluvial Fan Sites:
A1: Polygon 148 Ag/Poa Poverty Flats, section 7SW
A2: Polygon 148 Ag/Poa Peterson, section 6SW
A3: Polygon 148 Ag/Poa Chambers, section 4SW
A4: Polygon 148 Ag/Poa Peterson, section 1SE
A5: Polygon 179 Ag/Poa McBride, section 71SE
A6: Polygon 148 Ag/Poa Chambers, section 8NW

Some slight changes to these
See Excel spreadsheet

DETAILED SAMPLING DESIGN:

May 2000 pre-sampling contact

April- At each study site all ungulate dung will be weighed within 1 square foot sample ring. Ungulate dung will be separated by species and current year/previous years. After weighing, all dung will be returned to sampled area. Since comparisons are paired, drying will not be necessary. Permanent sample sites are important to reduce variability and quantify manure accumulation change through time.

April- Plot clipped in exclosure and plot clipped outside exclosure. It is important that exclosure and non-exclosed areas are in areas of similar species composition and production. Get dry weight. Important that different sample sites are clipped each year, and that clipping sample sites do not overlap with other sample sites.

July-August- Infiltration. Use infiltrometer at sites where upper soil horizons are dry in July-August. I'm not sure if it will be appropriate to sample wet meadow sites. (Need Cook and Stubbendieck
1986)

July-August- Depth and abundance of roots using standard auger to determine depth of the "many, common" class of roots (Need Soil Survey Staff 1975). These should be sampled at a different place each sampling period.

July-August- Daubenmeir plots to estimate % cover by species and % bare ground. Important to have permanent sampling sites.

COST: 18 exclosures each using three corral panels. Estimated cost per corral panel is $55.00 not including shipping: $2970. Will also need cable to secure panels to each other (six three foot lenghts, 18 ft of cable per exclosure, 324 feet total), crimps splices to connect cable to itself (nicopress sleaves, at least 110). Nicopress fencing tool or something that will crimp cable splices. Do we have one? Rebar to secure exclosure to ground (six pieces per exclosure) two feet in length, sharpened to point and bent like a candy cane, and ways to permanently mark sample plots: I suggest one central permanent marker to reference the daub. plot on. Other permanent sample plots referenced from this point, markers might not be necessary for other points but a clear record of position relative to the central point must be developed for manure sampling, and infiltration sampling. A sampling regime must developed to ensure that clipping for offtake sampling and augering for root depth do not occur in the same spots over time and do not affect the permanent manure and and infiltration plots.

Infilitrometer Cost: $319.00 in Forestry Suppliers
Auger for sampling root depth or a probe? Seems like something that samples an intact core is necessary: Need more information on this type of sampling.