2007 RANGELAND VEGETATION ASSESSMENT AT THE O'NEAL ECOLOGICAL RESERVE, IDAHO

Jacob T. Tibbitts, Jamey Anderson, and Keith T. Weber
GIS Training and Research Center
Idaho State University
Pocatello, ID 83209-8104
(http://giscenter.isu.edu, e-mail: giscenter@isu.edu)

ABSTRACT
Vegetation data was collected at stratified, randomly located sample points between June 18 and July 16, 2007 (n=148). Data was collected through both ocular estimation and line-point intercept transects each describing the 1) percent cover of grasses, forbs, shrubs, litter and exposure of bare ground 2) dominant weed and shrub species, 3) fuel load, 4) sagebrush age, 5) GAP land cover class, 6) presence of microbial crust, 7) litter type, 8) forage availability, and 9) photo points. Sample points were stratified by grazing and total rest treatments. The three strata (HISD, rest-rotation, and total rest) had variations in the ground cover perhaps due to the different treatments.

KEYWORDS: vegetation, sampling, GIS, remote sensing, GPS, grazing treatment, land management.

INTRODUCTION

Many factors influence land cover changes. Wildfire has been, and will always be, a primary source of broad scale land cover change. Also, grazing management decisions and practices has been linked to land cover change. With wildfire or grazing, a change in plant community composition, plant structure, or ecosystem function may result in increases in bare earth exposure and decreases in land sustainability. In some systems, native plants are in competition with non-native vegetation that is more aggressive. The increase of non-native vegetation can directly result in the reduction of livestock and wildlife carrying capacities. Fire frequency may also increase. An example of non-native vegetation that out competes native vegetation and increases fire frequency is cheatgrass (*Bromus tectorum*). A research project located at the O'Neal Ecological Reserve is being conducted to A) determine if planned, adaptive grazing can be used to effectively decrease bare earth exposure B) determine if ground moisture changes relative to bare earth exposure and livestock grazing and C) examine the ecological effects of livestock grazing. The approximate location of the study area is shown below (Figure 1).

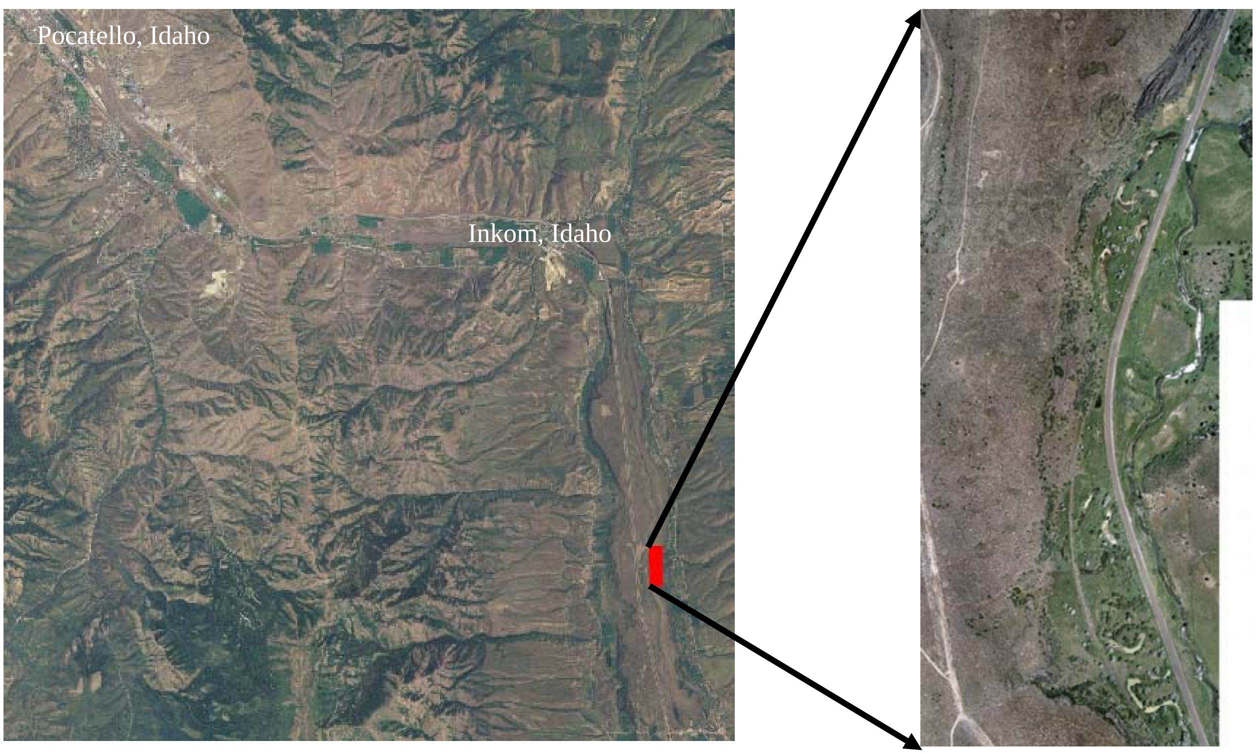

Figure 1- Research study area. The O'Neal Ecological Reserve, represented by red rectangle, is located near McCammon, Idaho.

We sampled three different grazing treatments; adaptive (high intensity/short duration (HISD)), rest-rotation (traditional), and total rest (no grazing). After comparing various traits in each of these areas we infer various generalizations which can shed light on relationships between these variables and may aid range managers in making decisions about prescribed and targeted grazing management.

METHODS

Sample points were randomly generated across the study area. Each point met the following criteria:

1) >70 meters from an edge (road, trail, or fence line)
2) <750 meters from a road.

The sample points were stratified by grazing treatment with 50 points in each treatment for a total of 150 sample points. The three grazing treatments were: 1) adaptive (HISD) 2) rest-rotation and 3) total rest.

The location of each point was recorded using a Trimble GeoXH GPS receiver (+/-0.20 m after post processing with a 95% CI) using latitude-longitude (WGS 84) (Serr et al., 2006). Points were occupied until a minimum of 20 positions were acquired and WAAS was used whenever available. All points were post-process differentially corrected using Idaho State University's GPS community base station. The sample points were then projected into Idaho Transverse Mercator NAD 83 using ESRI's ArcGIS 9.2 for datum transformation and projection (Gneiting, et al., 2005).

Ground Cover Estimation

Estimations were made within 10m x 10m square plots (equivalent to one SPOT 5 satellite image pixel) centered over each sample point with the edges of the plots aligned in cardinal directions. First, visual estimates were made of percent cover for the following; bare ground, litter, grass, shrub, and dominant weed. Cover was classified into one of 9 classes (1. None, 2. 1-5%, 3. 6-15%, 4. 16-25%, 5. 26-35%, 6. 36-50%, 7. 51-75%, 8. 76-95%, and 9. >95%).

Observations were assessed by viewing the vegetation perpendicular to the earth's surface as technicians walked each site. This was done to emulate what a "satellite sees". In other words the vegetation was viewed from nadir (90 degree angle) as much as possible.

Next, transects were used to estimate percent cover of bare ground exposure, rock (>75 mm), litter, herbaceous standing dead, dead standing wood, live herbaceous species, live shrubs, and dominant weed. Percent cover estimates were made along two 10 m line transects. Transects were arranged perpendicular to each other and crossing at the center of the plot at the 5 m mark of each line transect. Using the point-intercept method, observations were recorded every 20 cm along each 10 m line, beginning at 10 cm and ending at 990 cm. The cover type (bare ground exposure, rock (>75 mm), litter, herbaceous standing dead, dead standing wood, live herbaceous species, live shrubs, and dominant weed) at each observation point was recorded (n = 50 points for each line transect and 100 points for each plot).

The litter cover type included biomass that was on the ground and in contact with the ground. Live herbaceous species included live (i.e., green) forbs and grasses, while live shrubs included all species of shrubs.

Fuel Load Estimation

Fuel load was estimated at each sample point. Visual observations of an area equivalent to a SPOT 5 pixel, (10 mpp or approximately 100 m^2), centered over the sample point were used to estimate fuel load. These categories were derived from Anderson (1982) (Table 1).

Table 1-Fuel load classes and associated tonnage of fuels.

Fuel Load Class	Tons/acre
1	0.74
2	1.00
3	2.00
4	4.00
5	>6.0

Forage Measurement

Available forage was measured using a plastic coated cable hoop 2.36 m in circumference, or 0.44 m^2. The hoop was randomly tossed into each of four quadrants (NW, NE, SE, and SW) centered over the sample point. All vegetation within the hoop that was considered forage for cattle, sheep, and wild ungulates was clipped and weighed (+/-1g) using a Pesola scale tared to the weight of an ordinary paper bag. All grass species were considered forage. The measurements were then used to estimate forage amount in AUM's, pounds per acre, and kilograms per hectare (Sheley et al. 1995).

Microbiotic Crust Presence

Microbiotic crusts are formed by living organisms and their by-products, creating a surface crust of ground particles bound together by organic materials. Presence of microbial crust has been linked to degraded rangelands, but is still seen as being better that bare ground as they can retain water very well even against an osmotic pull helping to reduce erosion (Johnston 1997). The presence of microbiotic crust was evaluated at each sample point and recorded as either present or absent. Any trace of a microbiotic crust was defined as "presence".

GAP Analysis

Land cover was described using a list of vegetation cover types from the GAP project (Jennings 1997). The GAP vegetation description that most closely described the sample point was selected and recorded.

Litter Type

Litter was defined as any biotic material that is no longer living. Litter decomposes and creates nutrients for new growth. For the litter to decompose it needs to be in contact with the ground in order for the microbes in the ground to break down the dead substance. If the litter is suspended in the air it turns a gray color and takes an immense amount of time to decompose through chemical oxidation. If it is on the ground it is a brownish color and decomposes biologically at a much faster rate. The type of litter present was recorded by color: either gray (oxidizing) or brown litter (decaying).

Big Sagebrush (Artemisia tridentata spp.) Age Estimation
Maximum stem diameter (up to the first 0.30 m of stem) of Big sagebrush plants was measured using calipers (+/-1cm) to approximate the age of each plant (Perryman and Olson 2000) A maximum of four samples were taken at each sample point, one within each quadrant (NW, NE, SE, and SW). The sagebrush plant nearest the plot center within each quadrant was measured using calipers (+/-1cm) and converted to millimeters. The age of each big sagebrush plant was then estimated using the following equation (AGE = 6.1003 + 0.5769 [diameter in mm]).

Photo Points
Digital photos were taken in each of 4 cardinal directions (N, E, S, and W) from the sample point.

RESULTS
Ground Cover Estimates
Based upon ocular estimates, ten percent of all 2007 field samples (n = 14) had >50 % exposed bare ground and 77 % of samples (n = 113) has bare ground exposure <=35 %. The dominant weed present in 100 % of the 2007 samples was cheatgrass. Eighty-one percent of the sample points had >5% cheatgrass cover where the majority, 82 %, were <= 25 % cover and the maximum cover of cheatgrass was 51-75 % with 1.4 % of samples (n = 2) falling within the maximum range. The majority, sixty-one percent, of the samples had <16 % grass cover.

Based upon transect estimates, the maximum bare ground exposure was 86%, the maximum cheatgrass cover was 53%, the maximum grass cover was 34%, the maximum shrub cover was 66% and the maximum forb cover was 26%.

To truly understand ground cover estimates in relation to grazing treatments, each grazing treatment was independently analyzed. The mean cover classes of each cover type were separated by grazing treatment and are summarized in Table 2.

Table 2- Mean cover class of each cover type separated by grazing treatment.

Cover Class	Adaptive Mean Cover	Rest-Rotation Mean Cover	Total-Rest Mean Cover
Bare ground	16-25%	26-35%	16-25%
Shrub	26-35%	36-50%	26-35%
Grass	6-15%	1-5%	6-15%
Litter	26-35%	6-15%	6-15%
Weed	6-15%	16-25%	16-25%
Forb	6-15%	1-5%	1-5%

Ocular estimates were compared with the previous year, 2006. Compared to the 2006 mean cover class, bare-ground exposure has decreased in every grazing treatment. Mean shrub has increased in all but the total-rest treatment. Mean grass, litter, and forb have increased only in the adaptive treatement whereas mean litter decreased in both the rest-rotation and total-rest treatment. Mean weed cover has increased across each treatment.

To qualitativley visualize how the above changes in mean relate to the overall distribution of each cover class, frequency distributions of each cover class were also graphed from 2006 and 2007. The frequency distribution graphs of each grazing treatement from both 2006 and 2007 are shown in figures 2-7.

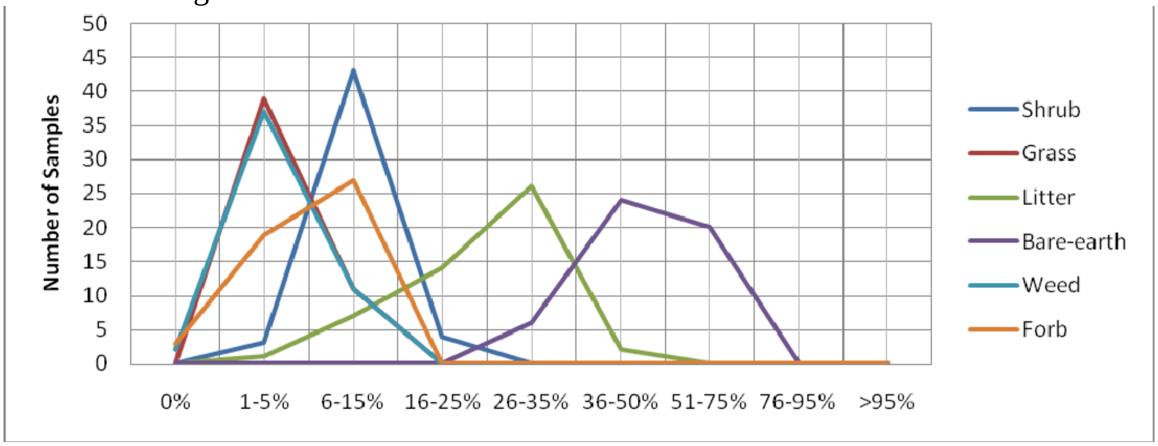

Figure 1- 2006 ground cover estimates in the adaptive grazing treatment. Cover classes are given along the horizontal (x) axis.

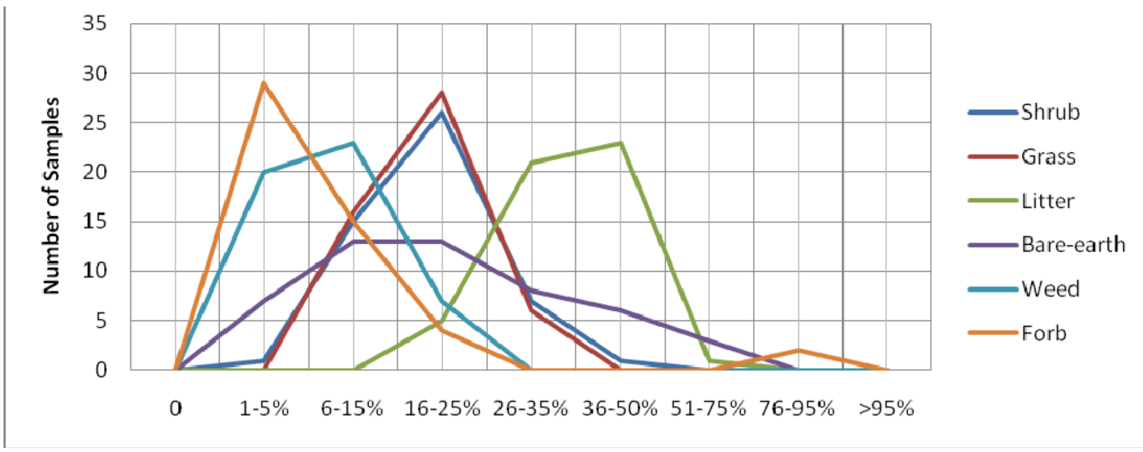

Figure 2- 2007 ground cover estimates in the adaptive grazing treatment. The cover classes are given along the horizontal (x) axis.

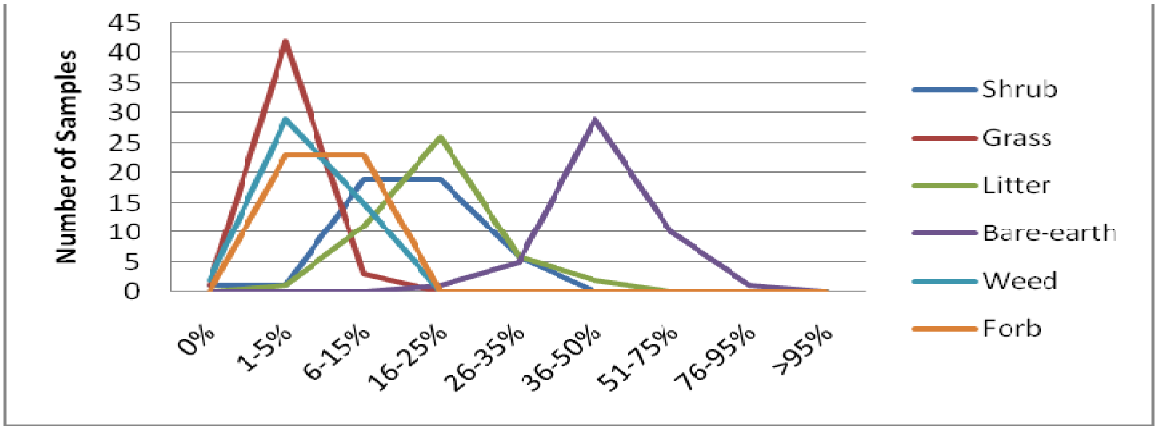

Figure 3- 2006 ground cover estimates in the rest-rotation grazing treatment. The cover classes are along the horizontal (x) axis.

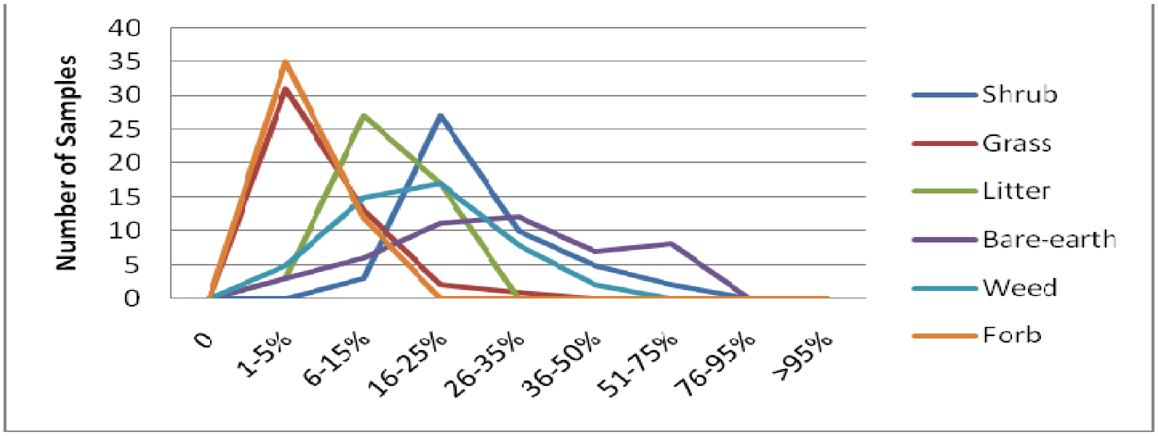

Figure 4- 2007 ground cover estimates in the rest-rotation grazing treatment. The cover classes are given along the horizontal (x) axis.

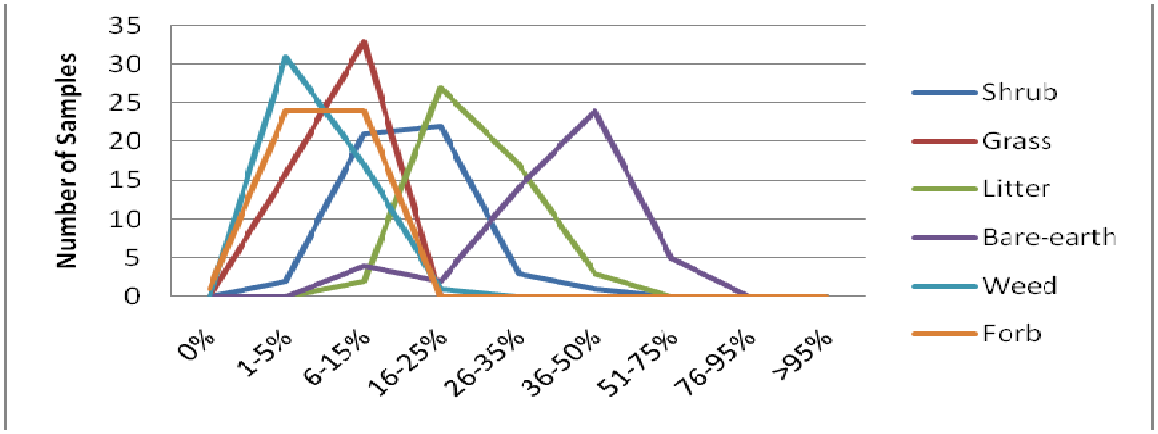

Figure 5- 2006 ground cover estimates in the total rest grazing treatment. The cover classes are given along the horizontal (x) axis.

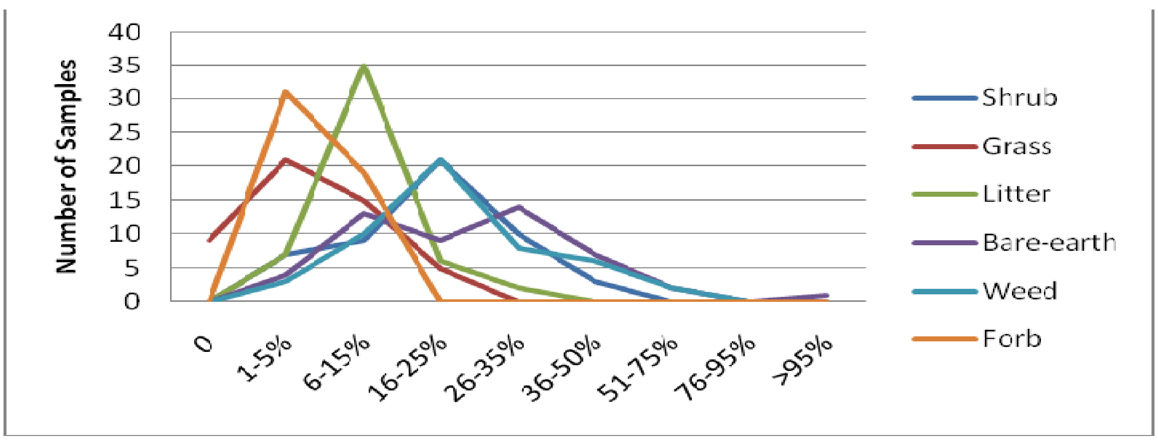

Figure 6- 2007 ground cover estimates in the total rest grazing treatment. The cover classes are given along the horizontal (x) axis.

A two-tailed Mann-Whitney U test was performed to quantify the difference between the distributions of cover classes in 2006 and 2007. The Mann-Whitney test asks if the distribution of a test statistic (ground cover) is the same across two samples. The Mann-Whitney test can be used regardless of distribution normality (mean, median, etc.) and can be used with categorical data (the type of data collected in this study). The results of the Mann-Whitney test are given in Table 3.

Table 3- Summary of two-tailed Mann-Whitney U-test results to determine if cover classes differed within treatment between years (2006 and 2007).

Adaptive	**P-Value**
Bare ground	0.000002
Shrub	0.000002
Litter	0.000002
Grass	0.000002
Weed	0.000136
Forb	0.804104 *
Rest-Rotation	
Bare ground	0.000006
Shrub	0.000004
Litter	0.000112
Grass	0.013150
Weed	0.000002
Forb	0.396219 *
Total-Rest	
Bare ground	0.000004
Shrub	0.123248 *
Litter	0.000002
Grass	0.000242
Weed	0.000002
Forb	0.404594 *

Note: cover classes indicated with an asterisk (*) did not differ between years.

Fuel Load Estimation

The majority of field samples (95%; n=140) had fuel load estimates between 2-5 tons/acre. The remaining 5 % (n=7) had fuel load estimates < 2 tons/acre. The occurrence of fuel loads < 2 tons/acre in 6 of the 7 samples were in areas of high lava rock exposure (>50%) and the remaining 1 sample that was not lava rock had high bare ground exposure >50%.

Forage Measurements

Using AUM Analyzer software (Sheley, Saunders, Henry 1995), forage amount and available Animal Units were calculated. Mean forage available was 77.99 kg/ha with a standard deviation of 61.16. The minimum forage available was 6 kg/ha and the maximum forage available was 287 kg/ha. Grazing treatments were separated to compare available forage between them (Table 4).

Table 4- A comparison of forage estimates across grazing treatments.

Grazing Treatment	Minimum (kg/ha)	Maximum (kg/ha)	Mean (kg/ha)	Standard Deviation
Adaptive	23	141	59.53	24.92
Rest-rotation	6	124	39.47	25.72
Total-rest	17	287	132.3	70.80

A statistical test was performed on the forage estimates to check differences between grazing treatment forage estimates. A simple ANOVA was performed which determined that the difference between mean forage estimates between grazing treatments were not statistically different (p=0.05). Furthermore, each grazing treatment was individually compared to each other through a paired *t*-test and the differences again were not significantly different. The paired *t*-test results are summarized in Table 5.

Table 5- Results of two-tailed t-test of forage means between grazing treatments. No significant differences were seen (95 % CI).

Hypothesis Tested	Difference Between Means	95% Confidence Interval for Difference Between Means	Two-Tailed P Value
Adaptive Mean = Rest-Rotation Mean	20.06	-51.04 to 91.16	0.52
Adaptive Mean = Total Rest Mean	-72.77	-221.72 to 76.18	0.33
Rest-Rotation Mean = Total Rest Mean	-92.83	-246.06 to 60.40	0.23

Microbiotic Crust Presence

In 2007, 86.4% of sample points (127 of 147) had microbial crust present. In 2006, 82.1% (119 of 149) had microbial crust. This change in presence of microbial crust is not significant within a 95% confidence interval.

GAP Analysis

Four GAP classifications were observed in 2007—vegetated lava, sagebrush grassland, big sagebrush, and bitterbrush. The majority of sample points (70%; n=103) were classified as sagebrush grassland, 19 % (n=28) as vegetated lava, 9.5% (n=14) as bitterbrush, and 1.4% (n=2) as big sagebrush.

Litter Type

Biologically decaying (brown) litter was dominant at 41% (n=60) of the sample points oxidizing (gray) litter was dominant at 1.4% (n=2) of the sample points while at 57.1% (n=84) of the sample points no discrimination of dominant litter type could be made and the litter type was classified as “both”.

Big Sagebrush Age Estimation

The mean age of sagebrush plants sampled was 18.75 years (n = 142). The minimum age was 8 years and the maximum age was 36 years. The standard deviation was 6.63159. Figure 5 shows the frequency distribution of sagebrush age.

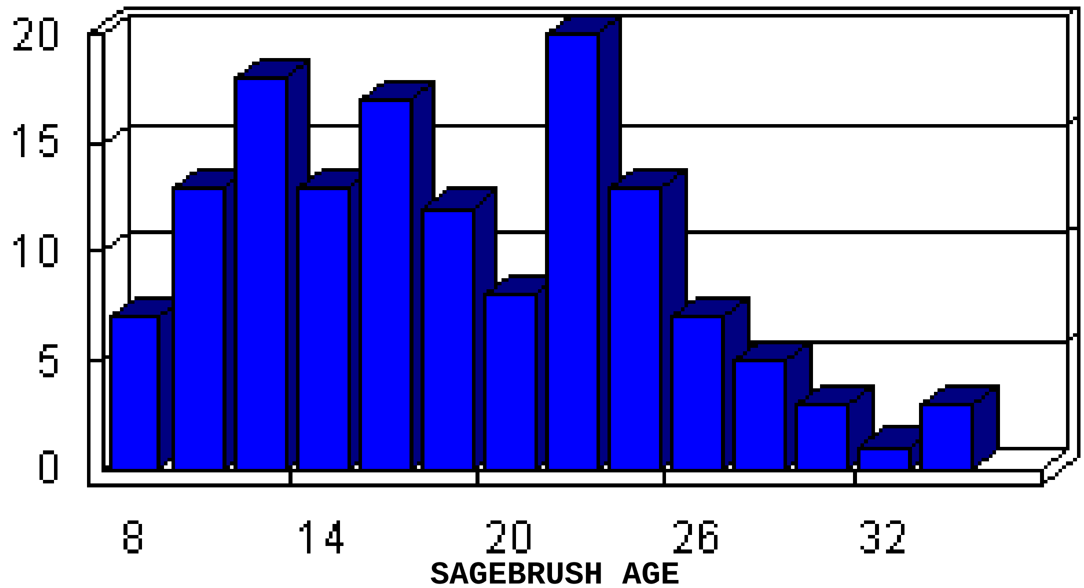

Figure 7- Cumulative frequency graph of sagebrush age estimates at the O'Neal Ecological Reserve.

CONCLUSIONS
The differences between the three treatments were interesting. Figures 2-7 are histograms of ground cover estimates comparison results from 2007 to those from 2006. There were significant differences in cover distributions that could be attributed to differing management practices. Further analysis and comparison with future sampling will hopefully provide better discrimination of these changes.

Desertification and land degradation is primarily evaluated through shifts of the keystone indicator, bare ground exposure. A land manager would want to see smaller percentages of bare ground exposure (i.e. the distribution curve shifts left) while grass, forb, shrub, and litter cover would preferably increase to higher percentages (i.e. the distribution curve shifts right). While differences in bare ground exposure and weed cover distributions (Figures 2-7) were significant in all treatments, it is the direction of the shift that is the major concern. Adaptive grazing appears to show the most promise in producing a relatively rapid shift of bare ground exposure toward smaller percentages. These early, albeit non-conclusive, trends can help to re-evaluate management decisions to correct or shift the changes toward more beneficial directions according to management goals and overall sustainability goals

It should be noted that the differences observed were most likely caused by different grazing treatments in each of the areas but observational bias and/or other environmental factors may have contributed to some of these changes. Furthermore, the sampling of the O'Neal was done only 3 weeks after grazing. Some of the changes that are shown, especially in grazed areas, could be different if sampling were done at a different time of year (i.e. pre-grazing or late Fall). However, the purpose of the total rest treatment is to infer the characteristics of the grazed treatments without grazing. But again, analyses of changes in relation to grazing are important in assessing management decisions. The primary goal should be early detection of degradation processes in order to make changes in management before it is too late or desertification thresholds are surpassed.

Regarding shrub cover, there has been an infestation of the sage defoliation moth (*Aroga coloradensis)* at the O'Neal site. In 2006, a large proportion of sagebrush was defoliated and therefore had no photosynthetically active leaves resulting in low sagebrush cover estimats. In 2007, there was a noted increase in recovering sagebrush resulting in higher leaf coverage than 2006. This information may explain the increase in shrub cover in the adaptive and rest-rotation pastures.

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