2008 Rangeland Vegetation Assessment at the O'Neal Ecological Reserve, Idaho

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ABSTRACT

Vegetation data was collected at stratified, randomly located sample points during May and June, 2008 (n=149). 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 plant age, 5) GAP land cover class, 6) presence of microbial crust, 7) litter type, 8) forage availability, and 9) name of collected photo point files. Sample points were stratified by grazing and rest treatments. The three strata (simulated holistic planned grazing, rest-rotation, and total rest) had variations in the ground cover due to the difference in 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 have 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 ground exposure and decreases in land productivity. In some systems, native plants are in competition with non-native vegetation that is more competitive. The increase of non-native vegetation can directly result in the reduction of livestock and wildlife carrying capacities. Fire frequency may also increase and as an example, cheatgrass (*Bromus tectorum*) has been shown to alter the fire regime in a very self-perpetuating feedback cycle. Research at the O'Neal Ecological Reserve is being conducted to A) determine if Simulated Holistic Planned Grazing can be used to effectively decrease bare ground exposure B) determine if soil moisture changes relative to bare ground exposure and treatment and C) examine the ecological effects of livestock grazing. The approximate location of the study area is shown below (Figure 1).

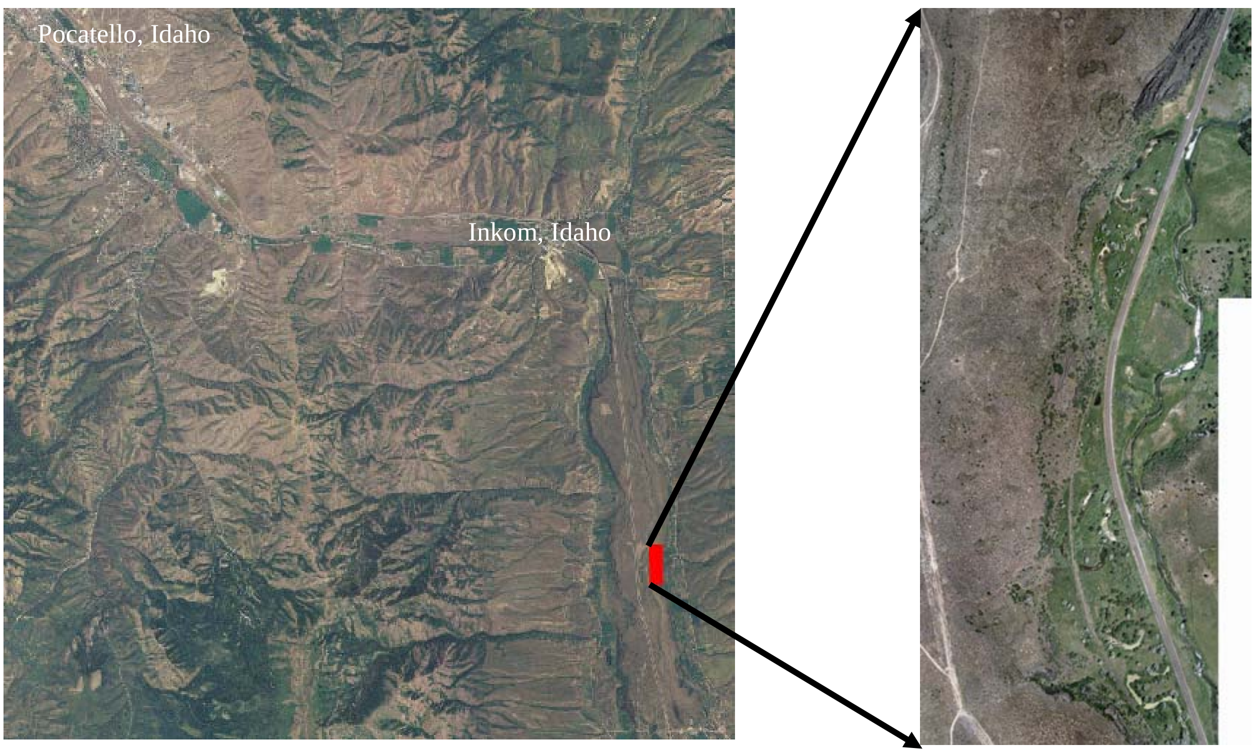

Figure 1. Research study area. The O'Neal Ecological Reserve, represented by red rectangle, is located near McCammon, Idaho.

We sampled three different grazing treatments; Simulated Planned Holistic Grazing (SHPG), 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 placed in each treatment for a total of 150 sample points. The three grazing treatments were: 1) Simulated Holistic Planned Grazing (SHPG) 2) rest-rotation and 3) total rest.

The location of each point was recorded using a Trimble GeoXH GPS receiver (+/-0.20 m @ 95% CI after post processing) 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 a long period of time to decompose through chemical oxidation. If it is on the ground, litter tends to take on 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, only seven percent of all 2008 field samples (*n* = 10) had >50 % exposed bare ground and 70% of samples (*n* = 105) had bare ground exposure <=35 %. The dominant weed present in 100 % of the 2008 samples was cheatgrass. Sixty percent of the sample points had >5% cheatgrass cover where the majority, 98%, were <= 25 % cover and the maximum cover of cheatgrass was 26-35 % with 1.3 % of samples (*n* = 2) falling within the maximum cover class range.

Based upon transect estimates, the maximum bare ground exposure was 35%, maximum cheatgrass cover was 28%, maximum grass cover was 33%, maximum shrub cover was 59%, and maximum forb cover was 49%.

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	SHPG Mean Cover Class	Rest-Rotation Mean Cover Class	Total-Rest Mean Cover Class
Bare ground	16-25%	6-15%	1-5%
Shrub	6-15%	6-15%	6-15%
Grass	6-15%	6-15%	6-15%
Litter	16-25%	6-15%	6-15%
Weed	1-5%	6-15%	6-15%
Forb	1-5%	6-15%	1-5%

Ocular estimates were compared with the previous year, 2007. Compared to the 2007 mean cover class, bare-ground exposure has decreased in the Rest-Rotation and the Total-Rest grazing treatments. Both treatment areas seemed to have a rather large decrease as Rest-Rotation moved from a mean cover of 26-35% to 6-15% and Total-Rest moved from 16-25% to 1-5%. Bare ground cover stayed the same in the SHPG area. The mean shrub and weed cover decreased in each treatment. Mean grass only increased in the Rest-Rotation treatement area. There was a decrease in the SHPG area for litter while the other treatment areas remained the same. Forbs decreased in the SHPG area, but had an increase in the Rest-Rotation area, and Total-Rest stayed the same.

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 graphed from 2007 and 2008. The frequency distribution graphs of each grazing treatement from both 2007 and 2008 are shown in figures 2-7.

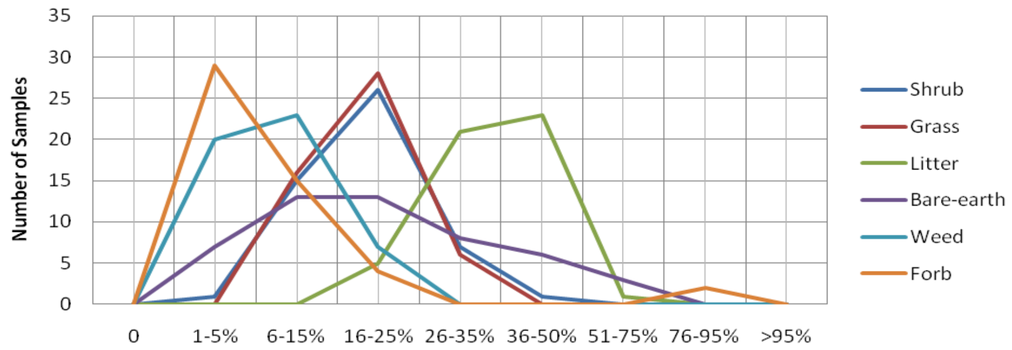

Figure 2. 2007 ground cover estimates in the SHPG grazing treatment. The cover classes are given along the horizontal (x) axis.

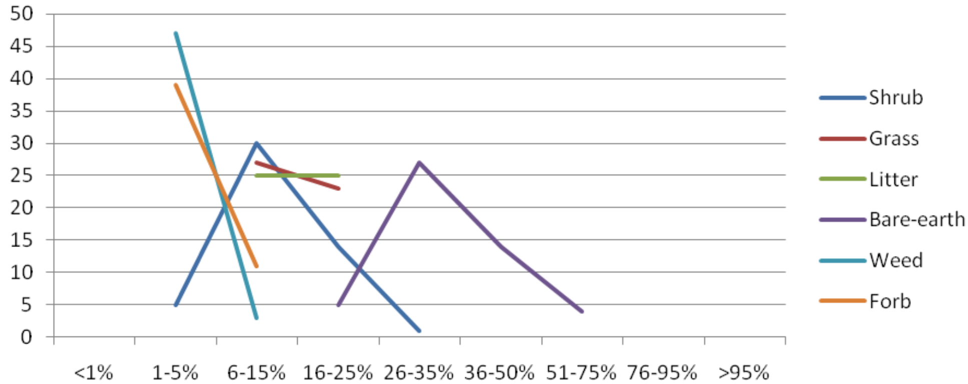

Figure 3. 2008 ground cover estimates in the SHPG grazing treatment. Cover classes are given along the horizontal (x) axis.

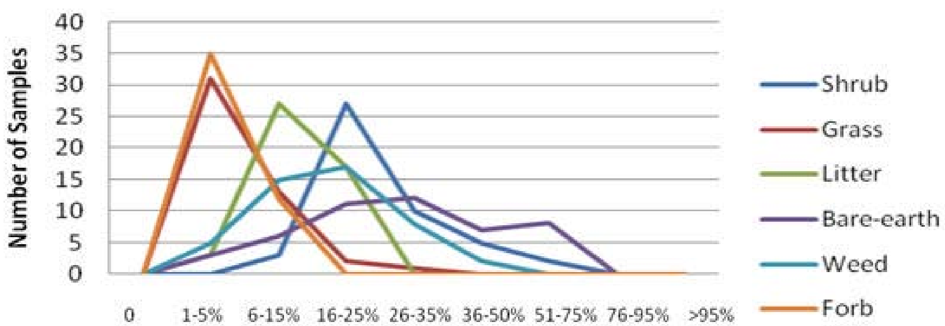

Figure 4. 2007 ground cover estimates in the rest-rotation grazing treatment. The cover classes are given along the horizontal (x) axis.

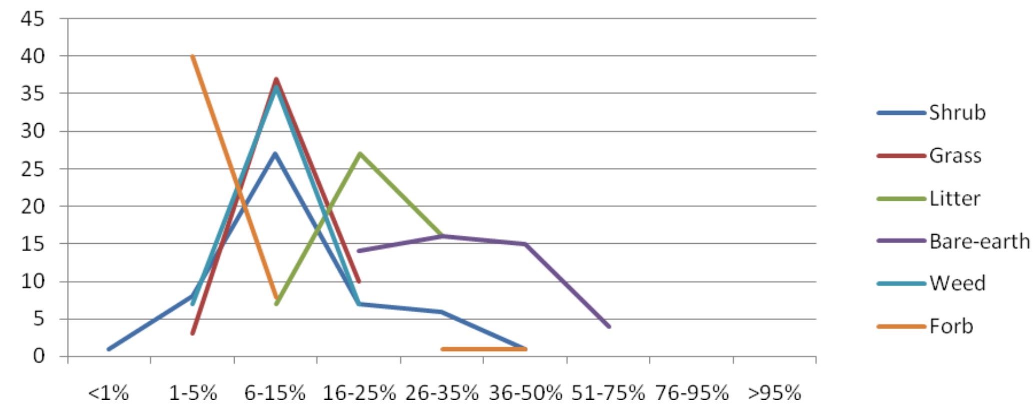

Figure 5. 2008 ground cover estimates in the rest-rotation grazing treatment. The cover classes are along the horizontal (x) axis.

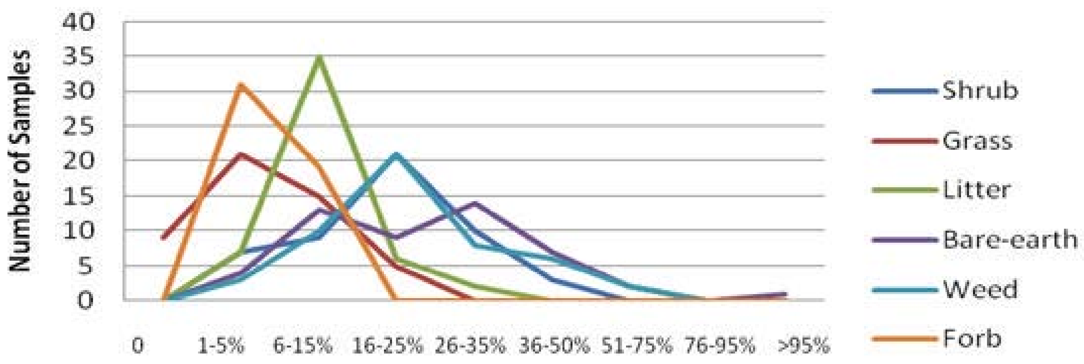

Figure 6. 2007 ground cover estimates in the total rest grazing treatment. The cover classes are given along the horizontal (x) axis.

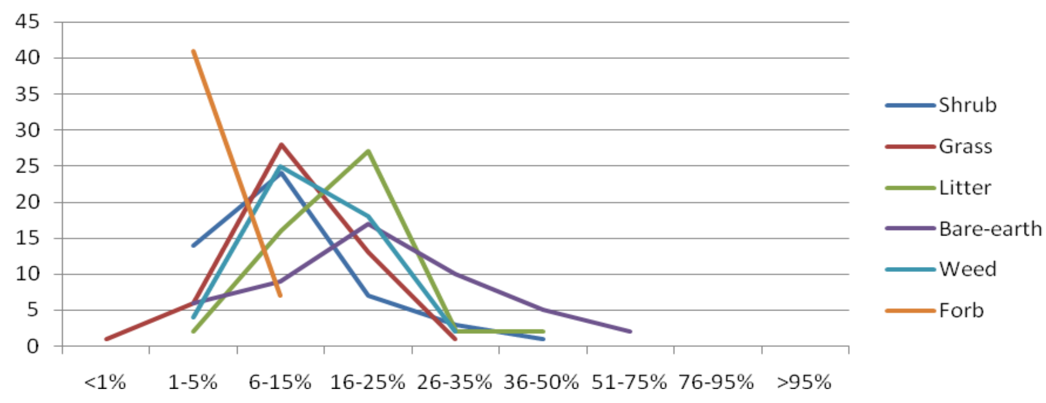

Figure 7. 2008 ground cover estimates in the total rest grazing treatment. The cover classes are given along the horizontal (x) axis.

STATISTICAL ANALYSIS

In order to better understand any differences between vegetation cover within each treatment, the ANOVA test was used. The ANOVA is a simple statistical test which compares varying observations and describes how much the observations differ from the sample mean. The ANOVA test was performed separately for each vegetation class (shrubs, grass, litter, bare ground, weed, and forbs) compared to the same class in the other treatment pastures. The P-Value is the "probability value that describes the likelihood the values tested are from the same population and therefore no different from one another". A P-Value of 1.0 would denote no difference while a P-value less than 0.001 would indicate a conservative difference in comparisons. With this in mind, shrubs, grass, and forbs did not have a significant P-value and no difference was assumed among pastures (Table 3). However, litter, bare ground, and weeds all had P-values well below 0.001. F-test results are also shown with F-value and F-critical values given (Table 3) which corroborate significance for these same comparisons. Looking at the F-critical compared to the F-value in Table 3, the difference is not significant for shrubs, grass, and forb classes. However, a difference was found in litter, bare ground, and weeds with the F-Value being much greater than the F-Critical.

Table 3. Results of Anova test between classes (F critical for this test was 3.058)

Class	P-Value	F-Value
Shrubs	0.230	1.483
Grass	0.003	6.111
Litter	$1.11\ E^{-12}$	33.437
Bare Ground	$1.99\ E^{-14}$	39.460
Weed	$7.45\ E^{-12}$	30.695
Forbs	0.087	2.4844

Included in the ANOVA test was a description of the average, or sample mean, between classes in each grazing treatment (SHPG, Rest Rotation, and Total Rest)(Table 4).

Table 4. Summary of Average (sample mean) between classes in each grazing treatments

Class	SHPG	Rest Rotation	Total Rest
Shrubs	11.1	10.8	13.8
Grass	13.8	8.9	12.2
Litter	18.6	12.1	8.4
Bare Ground	17.5	10.3	5.4
Weed	4.5	12.0	12.3
Forb	5.8	6.3	4.1

Fuel Load Estimation

The majority of field samples (87%; n=130) had fuel load estimates of 2 tons/acre. Four percent (n=6) of the field samples had a fuel load of 4 tons/acre which was primarily due to very dense areas of shrub. The remaining 8.7% (n=13) had fuel load estimates < 2 tons/acre. The occurrence of fuel loads < 2 tons/acre in 10 of the 13 samples were in areas of high lava rock exposure; (>50%) 2 of the samples were not in lava rock areas, but had high bare ground exposure with low shrub cover. The last remaining sample was in an area that was disturbed with low grass and no shrubs.

Forage Measurements

Using AUM Analyzer software (Sheley, Saunders, Henry 1995), forage amount and determined. Mean forage available was 127.44 kg/ha with a standard deviation of 61.16. The minimum forage available was 17 kg/ha and the maximum forage available was 767 kg/ha. Grazing treatments were separated to compare available forage between them (Table 5).

Table 5. A comparison of forage estimates across grazing treatments.

Grazing Treatment	Minimum (kg/ha)	Maximum (kg/ha)	Mean (kg/ha)	Standard Deviation
SHPG	28	186	79.18	24.92
Rest-rotation	17	231	71.86	25.72
Total-rest	34	767	233.41	70.80

Microbiotic Crust Presence

In 2008, 96% of sample points (143 of 149) had microbial crust present. In 2007, 86.4% of sample points (127 of 147) had microbial crust. This change in presence of microbial crust was not significant within a 95% confidence interval.

GAP Analysis

Four GAP classifications were observed in 2008—vegetated lava, sagebrush grassland, bitterbrush, and disturbed. The majority of sample points (61%; *n*=91) were classified as sagebrush grassland, 31.5% (*n*=47) as vegetated lava, 3.4% (*n*=5) as bitterbrush, and 0.6% (*n*=1) as disturbed. Five of the points did not contain data under the GAP classification.

Litter Type

Biologically decaying (brown) litter was dominant at 6.1% (*n*=9) of the sample points while oxidizing (gray) litter was dominant at 4.7% (*n*=7) of the sample points. The remaining 87.9% (*n*=131) of the sample points made no discrimination of dominant litter type and the litter type was classified as "both". Two of the points did not have any litter data recorded.

Big Sagebrush Age Estimation

The mean age of sagebrush plants sampled was 18.19 years (*n* = 149). The minimum age was 10 years and the maximum age was 47 years. Figure 8 shows a frequency distribution of sagebrush age.

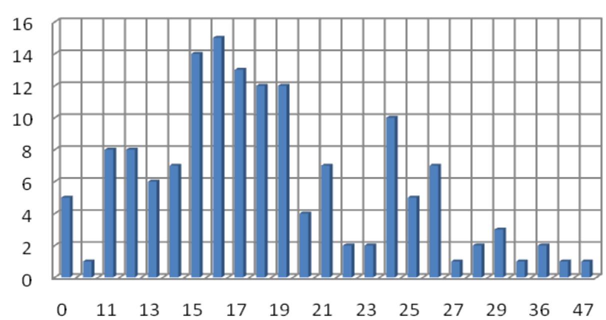

Figure 8. Cumulative frequency graph of sagebrush age estimates (X-axis) at the O'Neal Ecological Reserve, 2008.

CONCLUSIONS

The results from the 2008 field season were interesting when compared with the results from 2007. Figures 2-7 give a visual representation of changes between 2007 and 2008 for each vegetation class separated by treatment pasture. These graphs show a tendency towards a decrease in most cover classes. Weed and shrubs both saw a decrease in all grazing treatments with an increase of grass and forbs seen in the Rest-Rotation treatment area.

The mean forage estimates compared to 2007 saw a general increase especially in the Total Rest pasture. The mean increased from 132.3 kg/ha in 2007 to 233.41 kg/ha in 2008. In the Rest-Rotation pasture the mean increased from 39.47 kg/ha to 71.86 kg/ha in 2008 while the SHPG pasture had similar results increasing from 59.53 kg/ha in 2007 to 79.18 in 2008. The differences observed could be due to effective grazing treatments, but observational bias as well as environmental factors should be noted as possible influences to changes from the previous year. During the sampling process at the O'Neal rain fell consistently throughout the time spent on site. If the grass clippings had absorbed a lot of rain water at the time of weighing, the final weight would have been altered especially if the samples were not thoroughly dried prior to weighing. This factor may be the reason for the large increase in average forage weight from 2007 to 2008. Again, further comparison and sampling will better analyze this trend, and help to conclude if the grazing treatments are effective.

It is important for a land manager to see smaller percentages in bare ground exposure. The Rest-Rotation treatment area as well as the Total Rest area both saw a decrease in bare ground exposure while the Simulated Holistic Planned Grazing allotment kept the same average percent range from 2007 to 2008. Looking at the results from the 2007 study shows there was a decrease in the SHPG treatment from 2006 in overall bare ground exposure. This means the SHPG allotment is moving towards decreased bare ground exposure. On average the percentage remained the same, and it is important to note there was not an increase. If the study were to continue, it would be interesting to learn if these trends will continue towards a decrease in bare ground exposure.

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