Range Vegetation Assessment in the Big Desert, Upper Snake River Plain, Idaho 2008

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ABSTRACT

Vegetation data was collected at 99 randomly located sample points between June 10 and July 11, 2008 in the US Department of Interior, Bureau of Land Management Big Desert Region. Data was collected describing the 1) percent cover of grasses, shrubs, litter, and bare ground, 2) dominant weed and shrub species, 3) fuel load, 4) sagebrush age, 5) GAP land cover classification, 6) presence of microbial crust, 7) litter type, 8) forage availability, and 9) photo points. Sample points were stratified by fire and grazing treatments. An analysis of these data including a comparison of burned and unburned areas (based upon the 2006 Crystal Fire boundary) indicate that in the two years following the fire there has been a slight reduction in bare ground exposure with an increase in weed and litter ground cover. Biomass measurements, however, indicate a continual decline in available forage. This decline can also be seen in the reduction of grass as a ground cover. The percent cover of shrubs inside the fire boundary was equivalent to that of the previous year and continues to be less than that of pre-fire conditions.

KEYWORDS: sampling, GIS, remote sensing, GPS

INTRODUCTION

Sagebrush steppe is an extensive and important range cover type in North America extending over 400,000 km^2 of the Columbia and Snake River Plateaus (Anderson and Inouye, 2001). To conserve and manage these rangelands, it is essential to have a clear understanding of their ecological processes, functions, and the mechanisms that drive change. The mechanisms or primary drivers of land cover change in rangeland ecosystems include fire, invasive weeds, and urbanization.

Within the sagebrush steppe environment, wind erosion hazard is high, vegetation is dry, and perennial vegetation recovery rates are slow. Consequently, wildland fire is the driver considered most destructive in this ecosystem. Yet fire frequencies have increased due to the introduction of non-native, less palatable, and more readily combustible grasses such as cheatgrass (*Bromus tectorum*) (Anderson and Inouye, 2001). Following the 2006 field season, the Crystal Fire spread over the Big Desert study area and burned approximately 89,000 hectares. The data collected in 2007 and 2008 from the burned sites and immediately adjacent unburned sites describe various trends in post-fire recovery.

The purpose of this study was to collect field data from the Big Desert rangeland area (managed by the USDI BLM) and compare these data to results from previous research in land cover change and rangeland health modeling from the same study area, namely the Big Desert of southeastern Idaho. This study follows seven sequential annual studies of the same area (2000 to 2007) (Anderson et al, 2008; Gregory et al., 2008; Russell and Weber, 2003; Sander and Weber, 2004; Underwood et al, 2008; Weber and McMahan, 2005). The data collected in 2008 and the previously collected data illustrate various trends in shrub, litter, bare ground, and grass cover in response to fire and or other drivers of land cover change.

METHODS

The study area, known as the Big Desert, lies in southeastern Idaho, approximately 71 km northwest of Pocatello. The center of the study area is located at 113º 4' 18.68" W and 43º 14' 27.88" N (Figure 1) and is managed by the Bureau of Land Management (BLM).

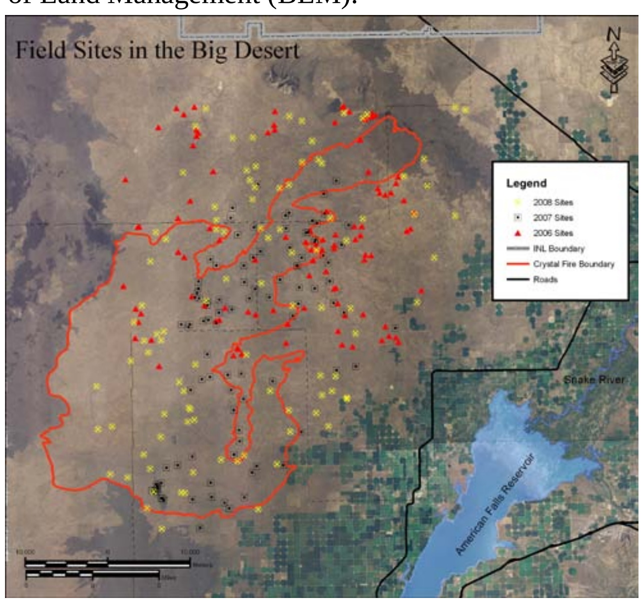

Figure 1. The crystal fire and sampling points from 2006, 2007, and 2008.

The Big Desert is a sagebrush-steppe semi-arid desert containing a large variety of native species as well as invasive species. Geologically young lava formations border the area to the south and west. Irrigated agricultural lands border the study area to its north, south and east. The area has a history of livestock grazing and wildfire occurrence.

The random point generation tool from Hawth's Analysis Tools was used to generate random sample points (*n*=99) across the study area (Figure 1) (Beyer, 2004). The limiting criteria for point selection was a distance of >70 meters from a road, trail, or fence line (to avoid edge effects), and < 750 meters from a road to aid researchers in navigating to sample points on foot.

Each point was navigated to and the location of the point was recorded using a Trimble GeoXH GPS receiver using latitude-longitude (WGS 84). Points were occupied until a minimum of 60 positions were acquired and Wide Area Augmentation System (WAAS) was used whenever available. All points were post-process differentially corrected (+/-0.20 m with a 95% CI) using an array of southeastern Idaho continuously operation reference stations (CORS) each located <80 km of the study area. All sample points were projected into Idaho Transverse Mercator NAD 83, using ESRI's ArcGIS (Gneiting, et al., 2005).

At each sample point, the area equivalent to a single SPOT5 pixel (10 mpp or approximately 100 m^2) centered over the sample point was examined to estimate the percent of bare ground exposure, vegetation ground cover, fuel load, and forage. Theses estimations and other descriptive characteristics such as the presence of microbiotic crust, the type of decaying litter, GAP land cover class, sagebrush age, and field photographs were recorded using an ArcPad Application installed on the Trimble GeoXH GPS receiver.

Ground Cover Estimation

An ocular estimate of the percent of ground cover in each 10 x 10m area was made and used to classify cover into one of nine classes (None, 1-5%, 6-15%, 16-25%, 26-35%, 36-50%, 51-75%, 76-95%, and >95%). Researchers view the vegetation perpendicular to the earth's surface, to emulate the satellite perspective, and discuss the percent cover/exposure for each of the following; bare ground, litter and duff, grass, shrub, and dominant weed.

Fuel Load Estimation

Fuel load classes at each sample point were based on the types and quantities of vegetation found in the area. These classification groups (Table 1) based on earlier works of Hal Anderson (1982) were used to estimate the fuel load in the study area.

Table 1. Fuel load classes and associated tonnage of fuels (from Anderson 1982)

Fuel Load Class	(Tons/Acre)	General Description
1	0.74	Almost bare ground, very little vegetation
2	1.00	Grasses, some bare ground, few shrubs
3	2.00	Mixture of shrubs and grasses
4	4.00	Predominantly shrubs
5	>6.00	Shrubs to trees

Forage Measurement

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

Microbiotic Crust Presence

Microbiotic crusts (Johnston 1997) are formed by living organisms and their by-products, creating a surface crust of soil particles bound together by organic materials. These are common in very poor rangelands and are often one of the last organisms left alive during drought conditions. The 100m^2 area centered over the sample point is examined for the presence of microbiotic crust. Any trace of a microbiotic crust was defined as “presence” and recorded in the database as a Boolean true value.

GAP Analysis

Further description of the plant communities surrounding each sample point was made following GAP Analysis Project land cover descriptions (Jennings 1997). The GAP vegetation description that most closely described the sample point was recorded. In addition, a 30-meter radius around each point was viewed to determine if the surrounding area contained the same plant communities (homogeneous) or if there was a difference in vegetation land type (heterogeneous).

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 soil in order for the microbes in the soil 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 as gray (oxidizing) or brown (decaying).

Big Sagebrush (Artemisia tridentata spp.) Age Estimation

Maximum stem diameter of big sagebrush plants were used 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) centered over the sample point. The sagebrush plant nearest the plot center within each quadrant was measured using calipers (+/-1cm) and estimated 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 AND DISCUSSION

Percent Cover Bare Ground, Litter, Weed, Grass, and Microbiotic Crust

Only seven percent of all 2008 Big Desert field samples had >50% exposed bare ground. This is a substantial reduction from the 28% of all samples reported in 2007. This trend towards a reduction in bare ground was consistent both inside and outside the Crystal Fire Area. Of the 2006 Big Desert field samples, all samples showed < 50% exposed bare ground (Figure 2).

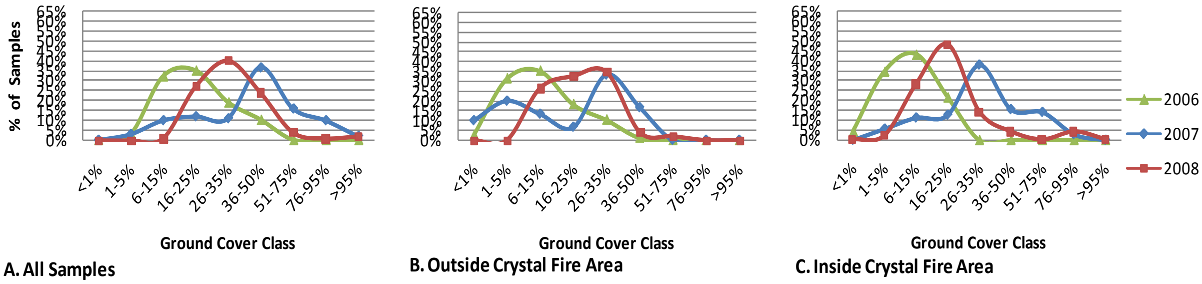

Figure 2. Bare ground exposure estimated in 2006-2008 for all samples (A), samples outside the fire perimeter (B), and samples taken inside the fire perimeter (C).

Fifty-nine percent of the samples collected in 2008 had litter in the 16-25% cover class. This is an increase in litter cover since the 2007 data collection (Figure 3).

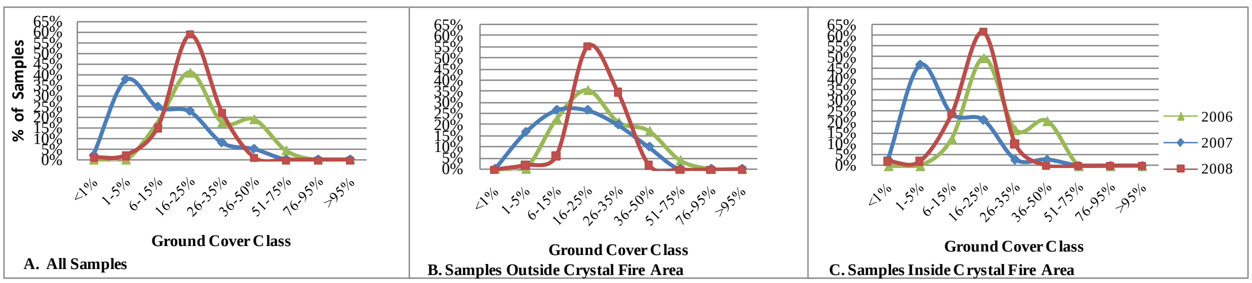

Figure 3. Litter cover estimated in 2006-2008 for all samples (A), samples outside the fire perimeter (B), and samples taken inside the fire perimeter (C).

Cheatgrass was present at 76% of all points sampled. Canada thistle (*Cirsium arvense*) was considered the dominant weed at 6% of all sample points. It is noted that Canada thistle had not been cited as a dominant weed during previous studies. Fifty-four percent of all 2008 sample points had >5% weed cover. This trend held true both inside and outside the Crystal Fire Area with >5% weed cover found at 51% of sample points outside the fire perimeter and at 56% of sample points inside the fire perimeter (Figure 4).

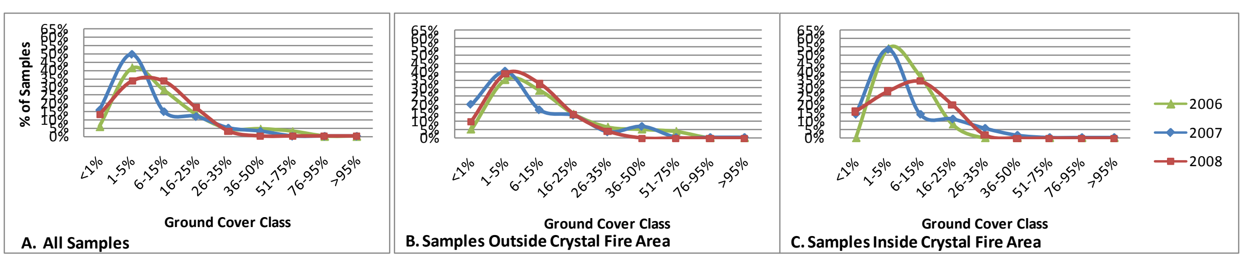

Figure 4. Weed cover estimated in 2006-2008 for all samples (A), samples outside the fire perimeter (B), and samples taken inside the fire perimeter (C).

At all 2008 sample sites, grass cover was < 36%. This was true both inside and outside the fire perimeter. Outside the fire perimeter, the most common cover class was 6 to 15%, while within the fire area the fire perimeter the most common cover class was 16 to 25% (Figure 5). The absence of samples with > 35% grass cover suggests a reduction in grass cover.

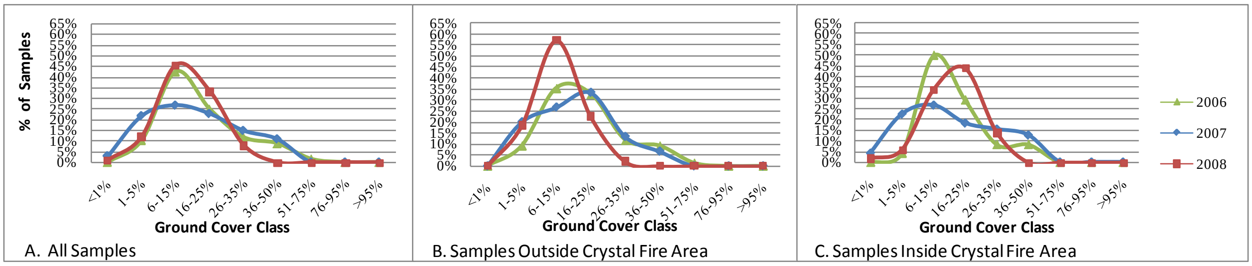

Figure 5. Grass cover estimated in 2006-2008 for all samples (A), samples outside the fire perimeter (B), and samples taken inside the fire perimeter (C).

Microbiotic crust was present at 27% of the points sampled while in 2007, microbiotic crust was present at only 10% of the points sampled.

Big Sagebrush Age Estimation

The mean age of sagebrush was 13.9 years (n = 91). The minimum age was eight years and the maximum age was 29 years.

Forage Measurements

The mean forage at the Big Desert study area was 252 kg/ha (Table 2). This mean value was lower than found both in 2006 and 2007 (461 and 362 kg/ha, respectively). Mean forage in 2008 inside the Crystal Fire perimeter was 296 kg/ha while 208 kg/ha was found outside the Crystal Fire perimeter (Table 2). The larger quantity of forage inside the Crystal Fire perimeter may be a function of the grazing restriction in place following the fire.

In 2007, sampling was done in the late spring (May 29 to June 13); but the 2008 sampling was done a little later in the summer (June 10 to July 11). Although, the sampling during a hotter and drier season may have biased the samples towards a lighter weight; the decreased forage in 2008 is consistent with the values seen for grass coverage (Figure 4).

Table 2. Forage measurements in the Big Desert 2006-2008 including a comparison of 2008 forage estimates both inside and outside the Crystal fire perimeter.

Big Desert Forage	*2006*	2007	2008	2008 Inside Crystal Fire Boundary	2008 Outside Crystal Fire Boundary
KG_HA					
Mean	460.6	361.9	251.7	296.0	208.4
Standard Error	32.3454	31.2413	22.1097	31.4591	30.1141
Median	383	259.1810	185.9342	239.4607	135.2249
Mode	208	0	124	152	124
Standard Deviation	323.4539	313.9716	217.7548	217.9548	210.7984
Sample Variance	104622.4444	98578.1696	47417.1711	47504.3086	44435.9672
Kurtosis	2.2170	0.5010	3.1396	1.5217	7.0615
Skewness	1.3496	1.1103	1.8212	1.3346	2.6119
Range	1617	1301.54	1014.19	963.48	997.28
Minimum	51	0	11.27	11.27	28.17
Maximum	1668	1301.54	1025.46	974.75	1025.46
Sum	46060	36555.79	24419.36	14209.88	10209.48
Count	100	101	97	48	49

CONCLUSIONS

Sampling results show some recovery following the Crystal fire of 2006 (i.e., estimated variables have moved closer to pre-fire conditions). However, current state and transition models suggest that a landscape may not return to pre-fire conditions (e.g., climax community) but rather a different condition that is equally stable (stable-state). Following the Crystal Fire, grazing has been restricted within the fire perimeter; however, available forage is still reduced relative to pre-fire conditions. Neither the median nor modal values for forage indicate a return to pre-fire status. Despite seeding (crested wheat grass [*Agropyron pectiniforme*]) inside the Crystal Fire perimeter, grass cover continues to be less than that of pre-fire conditions (Figure 5 and Table 2).

Shrub cover has also not returned to pre-fire status (Figure 6). The graph illustrating the samples collected inside the Crystal Fire perimeter (Figure 6C) indicates little change from 2007 to 2008; the dominant shrub in both years has been Green Rabbitbrush (*Chrysothamnus viscidiflorus*) which was expected as rabbitbrush is quick to colonize following fire.

Further comparisons of pre-fire and post-fire sampling data (Figure 2) show a reduction of bare ground both inside and outside the Crystal Fire area since 2007. Inside the Crystal Fire perimeter, the reduction of bare ground is a trend that appears to be returning to pre-fire status (Figure 2 C) with ground cover increases attributed to increases in weed and litter cover (Figure 3 and Figure 4).

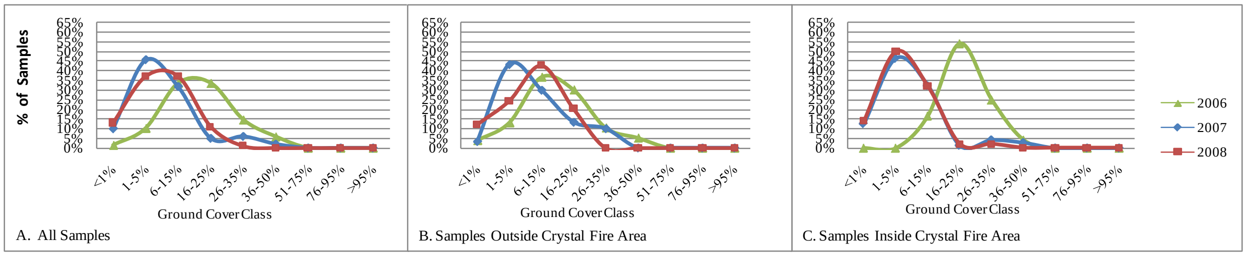

Figure 6. Shrub cover estimated in 2006-2008 for all samples (A), samples outside the fire perimeter (B), and samples taken inside the fire perimeter (C).

Analysis of the Big Desert study area vegetation sampling from 2006, 2007, and 2008 illustrates an effect of fire on shrubs and vegetation ground cover. These results suggest that following the Crystal Fire of 2006 vegetation ground cover has not yet recovered relative to pre-fire conditions.

ACKNOWLEDGEMENTS

This study was made possible by a grant from the National Aeronautics and Space Administration Goddard Space Flight Center (NNX06AE47G). Idaho State University would also like to acknowledge the Idaho Delegation for their assistance in obtaining this grant.

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Recommended citation style:
Tedrow, L, K. Davis, and K. T. Weber. 2009. *Range Vegetation Assessment in the Big Desert, Upper Snake River Plain, Idaho 2008*. Pages 41-50 in K.T. Weber and K. Davis (Eds.), Final Report: Comparing Effects of Management Practices on Rangeland Health with Geospatial Technologies (NNX06AE47G). 168 pp.

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