2011 Rangeland Vegetation Assessment in the Big Desert, Upper Snake River Plain, Idaho

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ABSTRACT

To better understand long term post-fire effects in sagebrush-steppe ecosystems, vegetation data were collected at 50 randomly located sample points during the month of June 2011. In particular, field samples were acquired on June 6-7, 13-14, 21-22, and 27-28th. Data were collected at the area known as the Big Desert using line-point intercept transects to characterize land cover. Additionally, sagebrush stem diameter measurements were taken to determine the average age of sagebrush plants. Average age estimations were used to analyze the recovery rate of sagebrush following the 2006 Crystal fire and thereby better understand fire intensity and severity at each sample site. Based upon a previous study using Local Net Primary Productivity Scaling, data collection and analysis included ten sites considered "always degraded" and ten sample sites considered "never degraded". The purpose of this data collection and analysis was to determine if a difference in land cover (by functional group) and sagebrush age existed within these two areas. Sites classified as "always degraded" had an average sagebrush plant age of 13.4 years while "never degraded" sites held a slightly higher average at 15.6 years. Grass was the most common cover type across all sites ($n = 50$) and rock was the least common. Areas considered "always degraded" were dominated by cheatgrass (*Bromus tectorum*) and litter while "never degraded" sites were dominated by shrubs and forbs. A difference in percent grass and shrub cover was found between "always degraded" and "never degraded" sites ($P < 0.05$).

KEYWORDS: Age estimation, GIS, vegetation, GPS, transects, land cover, degradation

INTRODUCTION

The study area, known as the Big Desert (Figure 1), is located in southeast Idaho, approximately 71 km northwest of Pocatello, Idaho and bordered on the west by the Craters of the Moon National Monument. The area is managed by the Bureau of Land Management (BLM) with current and historic livestock grazing being the primary treatment affect. Wildfire is a common disturbance and 58% of the study area has burned since 2000 with the Crystal fire burning 31% of the Big Desert in 2006 (Weber and Chen, 2011).

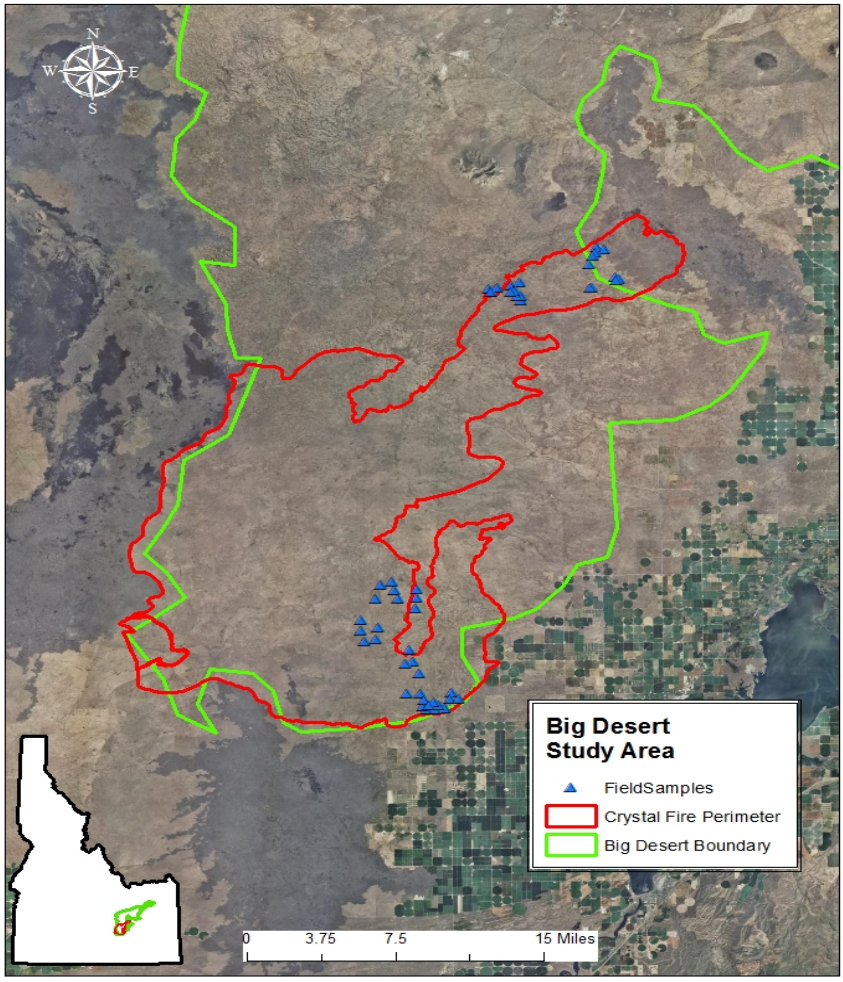

Figure 1. The Big Desert study area in SE Idaho and location of the Crystal Fire of 2006 along with field sample locations acquired in June 2011 (*n* = 50).

The Big Desert is a semiarid sagebrush-steppe ecosystem, surrounded to the north, south, and east by agricultural lands. The dominant shrub is sagebrush, with big sagebrush (*Artemisia tridentata*) being the most common. The herbaceous understory is comprised mostly of a mixture of grasses such as cheatgrass (*Bromus tectorum*), native grasses, and forbs. Cheatgrass is an invasive annual plant that contributes to a decreased fire return interval and increased fire severity. Areas dominated by cheatgrass tend to show decreased species diversity and increased susceptibility to severe soil erosion (Knapp, 1996).

There are many factors that influence land cover change. Wildfire has been, and will always be, a primary source of broad scale land cover change. The Crystal fire burned approximately 890 km^2 across the Big Desert study area between August 15 and August 31, 2006. This lightning-caused wildfire was the second largest documented in southeast Idaho since 1936 (Weber and Chen, 2011). To help characterize long-term post-fire recovery of this area and better understand the effect of USDI BLM rehabilitation efforts, a field sampling and data analysis campaign was designed for the summer of 2011. This paper describes the vegetation/land cover sampling performed during the summer of 2011 to support on-going rangeland research at Idaho State University's GIS Training and Research Center (Anderson et al, 2008; Gregory et al., 2008; Russell and Weber, 2003; Sander and Weber, 2004; Tedrow, Davis, and Weber 2008; Underwood et al, 2008; Weber and McMahan, 2005).

METHODS

Field Data Collection

Fifty random points were generated as field sampling sites using Hawth's tool in ArcGIS. Parameters constraining the location of the random points included the sites being 1) at least 70 m from anything that could be defined as an "edge" (fences, roads, permanent trails, etc.), and 2) within 750 m of a road to aid in access.

Each sample point was navigated to using a Trimble GeoXH GPS receiver (< 1.0 m @ 95% CI). This point was considered plot center. Photographs were taken using a Sony digital camera in each cardinal direction, starting with a view to the north and proceeding to photograph the eastern, southern, and western horizons. Maximum stem diameter of the sagebrush plant nearest plot center in each of four sampling quadrants (NE, SE, SW, and NW) were measured and recorded to the nearest millimeter and used to estimate sagebrush age. Sagebrush age was estimated following Perryman and Olson (2000) and Narsavage and Weber (2002) (equation 1).

$$\text{Age} = 6.1003 + 0.5769(\text{diameter}) \qquad \text{(Eq. 1)}$$

Transects extended 20 m directly west from plot center and indicated by a flexible tape which was laid over the ground from the starting point (plot center) with the aid of a compass. Land cover type was determined by looking straight down at the transect tape and recording the land cover feature in the upper most canopy directly above the designated observation point. Observation points began at 10 cm from the sample point (observation point one) and continued every 20 cm thereafter (observation points 2-100). Land cover at each observation point was classified as cheatgrass, other grass, litter, rock (over 75 mm), bare ground, shrub, forb, or other. A total of 100 point observations were made and recorded using a GPS-based field form and ArcPad 10.

Degradation classification

The process of identifying land degradation involved the application of land cover change analysis (Yuan et al. 1998). Local Net Primary Productivity Scaling (LNS) is one method used to identify land that has been degraded. Introduced by Prince (2004), LNS relies mostly on NDVI as the primary source of data and determines the potential productivity within biophysically homogenous areas in comparison to the

actual observed productivity (Weber and Chen, 2011). Calculating LNS requires two input layers; primary productivity (e.g., composite NDVI) and a land capability classification (LCC) layer.

To calculate composite NDVI (cNDVI), 24 Landsat 5 TM scenes (path 039 row 030) were acquired for the Big Desert study area between 2000 and 2009. Capturing peak annual photosynthetic activity was accomplished by acquiring one or two scenes in the spring (April or May) and one or two scenes in the early fall (September or October) (Tedrow and Weber 2010). A cNDVI layer was produced for each year.

LCC was derived using data from the SSURGO soils database and National Land Cover Database (NLCD). Within the Big Desert study area, 15 LCC regions were identified. The areas within each LCC where cNDVI values were > 2 standard deviations below the potential productivity were classified degraded (Weber and Chen, 2011). As a result of this determination annual LNS layers were created. By summing the Boolean equivalent of each annual LNS layer (0 = not degraded and 1=degraded), areas that were always considered degraded between 2000 and 2009 were identified (pixels with sum = 10). Likewise, areas that were never considered degraded were also identified (pixels where sum = 0). For this study, ten random sample points were chosen within areas considered "always degraded" (AD) and ten random sample locations were chosen within areas classified as "never degraded" (ND) .

Data analysis

Following collection of field data, the GPS receiver was downloaded and positions post-process differentially corrected using Trimble Pathfinder Office software with H-star technology and Delta phase processing. Percent cover at each sample point was calculated and used to compare land cover between AD and ND sites using Analysis of Variance (ANOVA).

RESULTS

Land cover

Based upon transect data collected during the summer of 2011 on June 6th, 7th, 13th, 14th, 21st, 22nd, 27th, and 28th, grass was determined to be the most common land cover type (x = 31.6%). Litter had a mean percent cover of 19.9%, while shrubs comprised 11% cover. Cheatgrass had an average of 9.0% cover across all sites (Table 1).

Table 1. Percent cover by cover type. All values are the percent total across all sites (*n*=50). "Missing" refers to the number of times a cover type was not found anywhere along a single transect.

	Cheatgrass	Litter	Other grass	Rock	Bare ground	Shrub	Forb	Other
Min	0	7	3	0	0	0	1	0
Max	53	35	59	34	31	38	33	1
Mean	9.0	19.9	31.6	7.6	10.5	11.0	10.3	0.1
Missing	8	0	0	21	1	8	0	49

Land cover in degraded areas

Results of single-factor ANOVA tests indicate a significant difference in certain land cover types between AD and ND sites ($P < 0.05$). In AD areas, cheatgrass and litter were the dominant cover type, whereas

shrub and forb were most commonly found at ND sites. These results suggest that cheatgrass may be displacing other plants in those areas affected by some disturbance such as recent wildfire or a high frequency of fires. In ND areas sagebrush is present at a much higher level (x = 15%). The remaining cover types showed no significant difference between groups (Table 2).

Table 2. Results of single-factor ANOVA comparing land cover types between always degraded (AD) and never degraded (ND) areas.

Cover Type	Mean percent cover		P-value
	AD	ND	
Cheatgrass	18.0	3.5	0.005*
Litter	24.2	14.1	0.003*
Shrub	3.5	15.2	0.009*
Forb	5.5	9.5	0.009*
Other grass	34.9	35.0	0.988
Rock	4.6	11.9	0.195
Bare ground	9.3	10.7	0.649
Other	0.0	0.1	0.330

* indicates a significant difference exists between AD and ND sites

Sagebrush age estimation

A maximum of four sagebrush stem diameter measurements were taken at each site and used to calculate sagebrush age (n = 104). Based upon sagebrush diameter measurements the mean age of all plants was 13.03 years. The oldest sagebrush plant recorded was 23 years while the youngest sagebrush plant recorded was 7 years. In analyzing only the AD sites, the average age was 13.4 years (n = 18), with the minimum age being 7 and the maximum being 21 years. ND sites had an average age of 15.6 years (n = 10) with the minimum being 12 and the maximum being 21 years (figure 2). No difference in sagebrush age was found between AD and ND sites (P = 0.44).

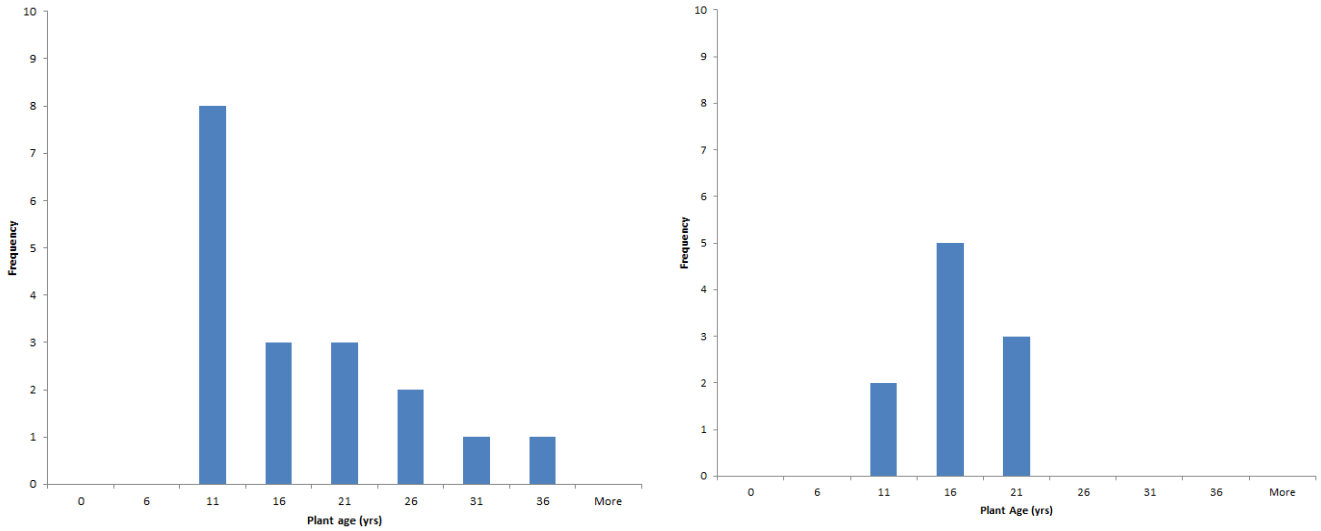

Figure 2. Histogram of sagebrush plant age at sites considered always degraded (left) and those considered never degraded (right) as a result of LNS modeling of the Big Desert between 2000-2009.

CONCLUSIONS

Transect data revealed that grass was the most common cover type among all sample points. AD areas tend to be dominated by Cheatgrass, whereas ND sites exhibited high proportions of shrub cover. ANOVA revealed a significant difference ($P < 0.05$) among Cheatgrass, litter, and shrub cover between AD and ND sites. The average age of sagebrush among all sample points was 13 years.

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