

2010 Rangeland Vegetation Assessment at the O'Neal Ecological Reserve, Idaho

Kerynn Davis, Idaho State University. GIS Training and Research Center, 921 S. 8th Ave., Stop 8104, Pocatello, ID 83209-8104

Keith T. Weber, GISP Director, Idaho State University. GIS Training and Research Center, 921 S. 8th Ave., Stop 8104, Pocatello, ID 83209-8104 webekeit@isu.edu

Darci Hanson, Idaho State University. GIS Training and Research Center, 921 S. 8th Ave., Stop 8104, Pocatello, ID 83209-8104

ABSTRACT

To better understand long term post-fire effects in sagebrush steppe ecosystems, vegetation data were collected and analyzed during the months of June and July, 2010. The study was conducted at the O'Neal Ecological Reserve in southeast Idaho on rangelands managed under rest-rotation grazing. Twig samples of both dead and live sagebrush were collected as part of this study to investigate subsequent areas of sagebrush die-off. Twig wet weights were acquired on-site, and again after the twig samples had been dried. Results showed a large difference between the wet and dry weights of the live sagebrush ($n = 10.4\text{g}$) while samples from dead shrubs did not show a significant difference between wet and dry weights ($n = 0.6\text{ g}$). Data describing the state of sagebrush plants were collected using ocular estimation (live or dead). In addition, the stem diameter of sagebrush plants was collected to estimate plant age. Average age estimations were used to compare the recovery rate of sagebrush following a 1992 wildfire. The average age of sagebrush plants within the fire perimeter ($n = 78$) was compared to the age of plants outside the fire perimeter ($n = 370$). Mean sagebrush age showed no difference between these areas (17.8 and 17.7 within the fire perimeter and outside the fire perimeter, respectively) indicating the sagebrush-steppe ecosystem of the O'Neal Ecological Reserve effectively shows no indications of the 18 year-old fire in the age stratification of sagebrush plants. This result concurs with observations from other studies suggesting sagebrush steppe rangelands often return to a pre-fire condition within 6-10 years of the disturbance.

KEYWORDS: Age estimation, sampling, GIS, remote sensing, GPS, grazing treatment, land management

INTRODUCTION

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. In addition, grazing management decisions and practices have also 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 and decreases in land productivity. The introduction of non-native vegetation can also lead to a degraded or disturbed system due to the competition placed upon native plant life and the change in plant community composition.

This paper describes the vegetation/land cover sampling performed during the summer of 2010 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). Research was conducted using random and directed sampling techniques to collect various sagebrush plant characteristics including twig weight, plant height, and plant age. These data were used to foster a better understanding of the effect of an 18 year-old fire (1992) at the O'Neal Ecological Reserve (Figure 1) with potential application to other semiarid rangelands around the world.



Figure 1. The focus of this study, the O'Neal Ecological Reserve, is located in eastern Idaho, just south of Pocatello.

METHODS

Study Area

Research at the O'Neal Ecological Reserve was conducted to determine long-term post-fire effects upon the sagebrush shrub community. The majority of the study area is actively grazed in the early summer (May), however the stocking density is very low (6 AUD ha⁻¹). In 2010, two treatments were sampled; rest-rotation grazing (RESTROT) and total rest (TREST). After comparing several metrics from each of these areas we made various inferences which may shed light upon relationships between the measured variables and thereby aid range managers in making decisions about long term post-fire management as well as prescribed/ targeted grazing.

Field Data Collection

Two sampling sessions were completed during the summer of 2010. The first session, consisted of randomly located sample points based on criteria determined prior to data collection and following protocols described at http://giscenter.isu.edu/research/Techpg/nasa_postfire/results.htm. This criteria ensured that all points were 10 meters from an edge (road, trail, or fence line). There were 60 random points generated throughout the O'Neal study area,

These sample points were 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. The site was then classified as being representative of a homogeneous live-sagebrush stand or a homogeneous dead-shrub stand. This was determined by predetermined standards for homogeneity based on the Data Collection Protocol. If the site was considered a dead-shrub stand, then the spatial extent of the homogeneous area was determined using a tape measurements to accurately determine the corresponding homogeneous pixel size, for example if the area was approximately 30 m x 30 m or larger in size, it was considered consistent with a Landsat 5 TM pixel. Similarly, sites could be classified as consistent with SPOT 5 (10 m x10 m or larger), or Quickbird/Worldview2 (2 m x 2 m or larger) (Hanson, 2010). The largest area of homogeneous consistency was recorded for each site. In addition, sagebrush twig samples were clipped from up to four sagebrush plants at each site and weighed using a Pesola scale (+/- 1 g). Selected twigs were approximately 5 mm in diameter and approximately 250 mm in length. A total of 30 live-sagebrush twig samples were taken as well as 30 dead-shrub twig samples. These samples were placed in a bag, labeled with a unique ID consisting of the sample point ID, date, and sequence (1-4) and returned to the laboratory for further analysis.

Maximum stem diameter of sagebrush plants were measured and recorded to estimate sagebrush age. A maximum of four samples were collected at each sample site with one taken from the nearest sagebrush plant in each quadrant (NE, SE, SW, and SE) arranged over plot center. Sagebrush age was estimated by measuring the maximum basal stem diameter using calipers. Sagebrush age was estimated following Perryman and Olson (2000) and Narsavage and Weber (2002) (equation 1).

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

An insufficient number of dead sagebrush sites were found during the initial sampling session ($n = 13$) and as a result, a directed sampling approach was used in the second sampling session. The directed

sampling approach is one where field personnel use their knowledge of the study area to locate additional sample sites. While this approach introduced a bias into the sample dataset it was effective for locating uncommon targets such as homogeneous stands of dead shrubs. When a new site was located, the same sampling protocol as described above was followed. The goal of the field collection campaign was to collect a minimum of 60 live- and 60 dead-sagebrush sites, each of which was homogeneous at one of the following spatial scales: 5 m², 100 m², or 1000 m². These spatial scales are equivalent to imagery collected by the WorldView2/Quickbird, SPOT 5, and Landsat satellites, respectively.

Laboratory and Statistical Analysis

All sagebrush twig samples ($n = 60$) were oven-dried at 75° C for 48 hours and re-weighed. These data were recorded in a MS Excel spreadsheet along with the wet-weight of each individual twig. Percent water content was then calculated and analysis of variance (ANOVA) used to determine if a difference existed in moisture content of live- and dead-sagebrush plants.

RESULTS

A total of 119 sample sites were collected in this study. Twenty of these samples were located within the 1992 fire perimeter of the O’Neal Study Area and 99 were located outside of the fire perimeter. A maximum of four sagebrush stem diameter measurements were taken at each site to calculate sagebrush ages ($n = 78$ and 370, respectively). Based upon sagebrush diameter measurements the mean age of all plants was 17.8 years. The oldest sagebrush plant recorded was located outside the 1992 fire perimeter and was 50.5 years while the youngest sagebrush plant recorded (7.8 years) was located within the 1992 fire perimeter (Table 1).

Table 1. Sagebrush age estimates at the O’Neal Ecological Reserve based upon 2010 field sampling relative to the 1992 wildfire.

	Within fire perimeter	Outside fire perimeter
<i>n</i>	78	370
Minimum age	7.8	8.4
Maximum age	41.8	50.5
Mean age	17.8	17.7

The mean age of sagebrush plants within the fire area did not differ greatly from mean sagebrush age outside the fire area ($P = 0.048$; $P_{critical} = 0.01$). The distribution of sagebrush plant age was concentrated largely among plants 10-20 years old both within the 1992 fire areas (Figure 2) and outside the fire area (Figure 3).

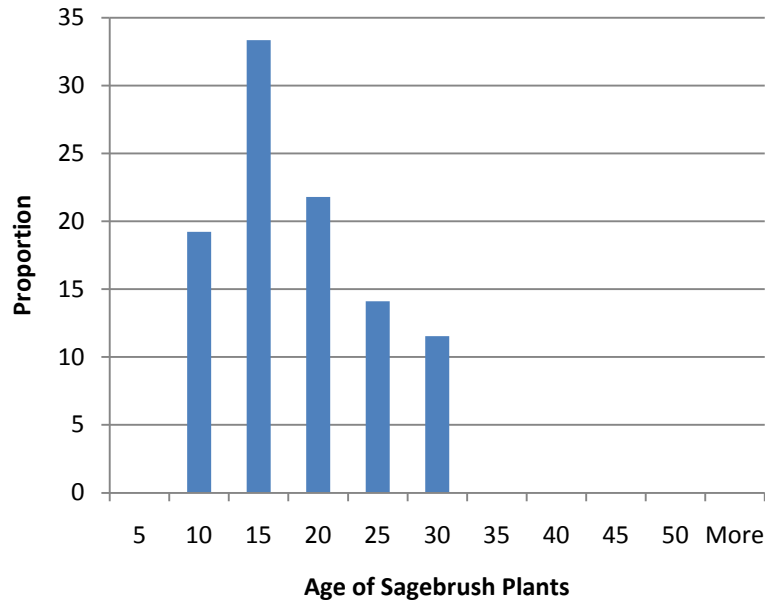


Figure 2. Age distribution of sagebrush plants within the 1992 wildfire area.

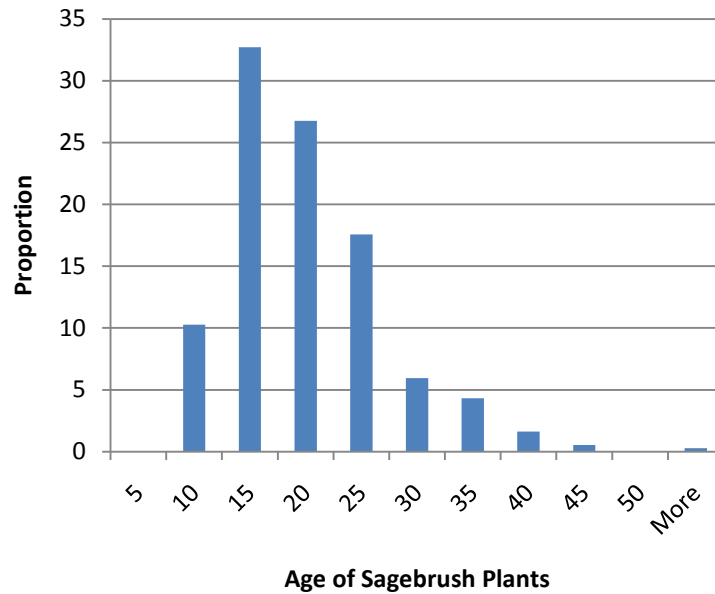


Figure 3. Age distribution of sagebrush plants outside the 1992 wildfire area.

Results of twig weight analysis showed a substantial difference between wet and dry weights of live sagebrush twig samples (Figure 4), but only a minor difference between wet and dry weights from dead shrub twig samples (Figure 5). Results of single-factor ANOVA tests indicate the wet weights between the two twig type groups (live and dead samples) were significantly different ($P < 0.001$) as were the dry weight comparison between the two twig type groups ($P < 0.001$). The results also showed a large difference between the average wet and dry weights of live sagebrush twigs ($n = 10.4$ g) while dead shrub twig samples did not show a difference in mean weight ($n = 0.6$ g).

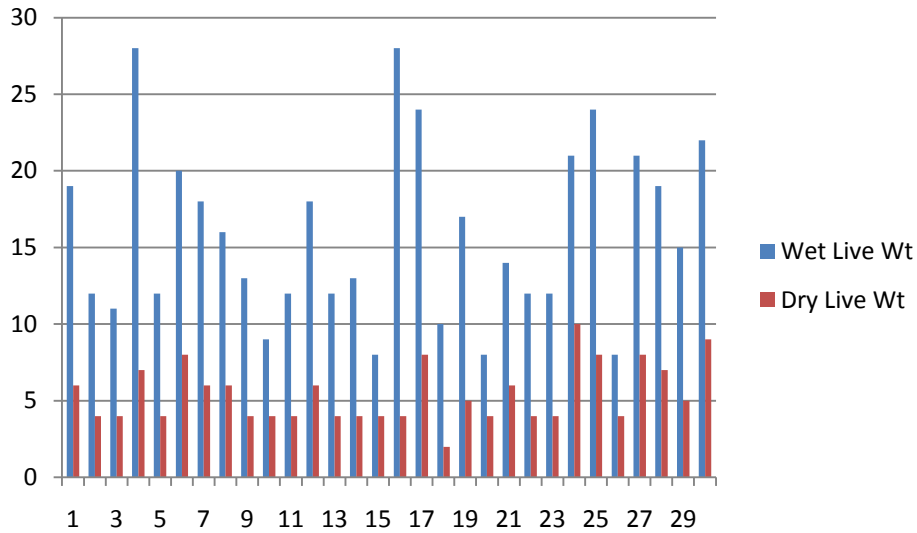


Figure 4. Comparison of wet and dry weights of live sagebrush twig samples (grams).

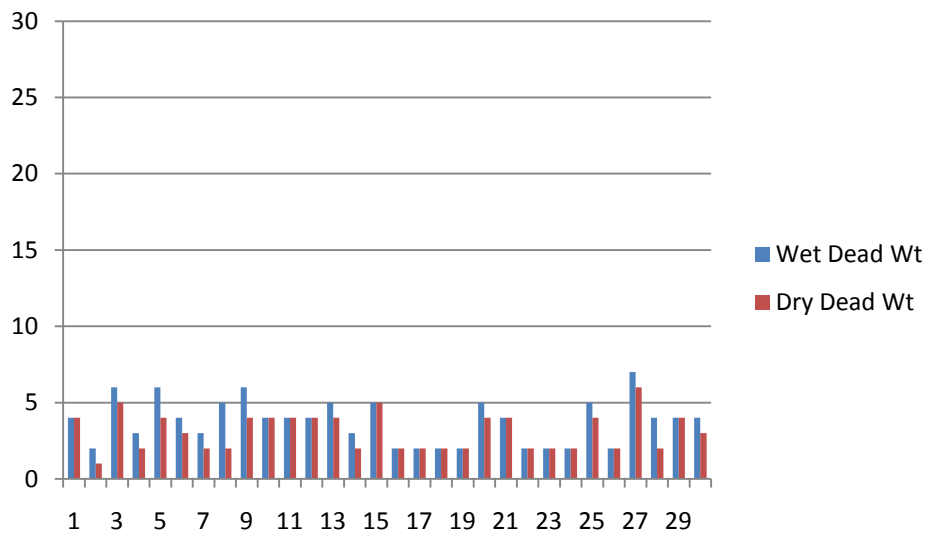


Figure 5. Comparison of wet and dry weights of dead sagebrush represented in grams.

CONCLUSIONS

The results from the 2010 field season revealed no appreciable difference in sagebrush plant age within and outside the 1992 fire area. In essence it appears that after 18 years, the rangeland ecosystem has recovered to pre-fire conditions save for the absence of some old individual plants. Sagebrush twig weight analysis indicated a significant difference between live and dead shrub twig weights which is likely attributable to a much higher water-content present in the live sagebrush plants. This physical difference between living and dead sagebrush plants may provide a potential to differentiate stands of living and dead sagebrush plants by leveraging the water-sensitive short wave infrared portions satellite sensors like Landsat and SPOT5. Additional research is required to determine if this potential can be fulfilled.

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