

**FIELD COLLECTION OF FUEL LOAD, VEGETATION
CHARACTERISTICS, AND FORAGE MEASUREMENTS ON
RANGELANDS OF THE UPPER SNAKE RIVER PLAIN, ID FOR
WILDFIRE FUEL AND RISK ASSESSMENT MODELS.
A FIELD SAMPLING REPORT**

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ABSTRACT

*Fuel load, forage availability, and vegetation characteristics were sampled for 129 randomly generated points across the sagebrush- steppe semi- desert in southeast Idaho. We collected percent cover, fuel load, forage availability, visual obstruction, habitat type, and big sagebrush (*Artemisia tridentata* spp.) age estimates. Samples were stratified by fire and grazing treatments. Our study showed that bare ground, short grasses, and > 61 cm (~2 ft) big sagebrush were the dominant cover types. Visual obstruction readings, forage samples, and fuel load assessments revealed that forage availability and fuel loads were low. Calculations of big sagebrush age revealed that the age of live sagebrush plants in our study area range from 7 to 92 years.*

Keywords: Grazing, Sagebrush-Steppe

INTRODUCTION

There has been a need to estimate rangeland wildfire danger since the 1940's (Burgan, 2000). Monitoring and inventory of rangeland wildfire factors, such as vegetation characteristics, litter, and percent bare-ground, are important fire hazard assessments to determine wildfire fuel load (Andersen, 1982). Modeling fuel load has become a valuable approach for the prediction of fire behavior and assessing the potential intensity and severity of wildfires (Andersen, 1982).

To effectively model wildfire potential with remotely sensed imagery, field samples of fuel load and vegetation condition needs to be collected. Ideally, correlates are then established between field data and the digital numbers recorded by the imagery. Researchers will then perform ground-truth sampling to validate the fuel load models and to assess the accuracy of the models.

Using data collected during the summer 2001 field season we will develop models to predict fuel load for our study area. Field data collected included fuel load estimations, forage material measurements, and vegetation characteristics.

Study Area

This study was conducted on land managed by the USDI BLM in the Upper Snake River Plain, Southeast Idaho (fig. 1). Sampling sites were found on Burley and Idaho Falls BLM Districts between 43°36'00" and 42°48'00" north Latitude and -113°35'00" and -112°37'59" west Longitude. This area is considered sagebrush-steppe semi-desert bordered by large, relatively recent lava formations to the south and west and irrigated agricultural lands to the east. This area has a history of livestock grazing and wildfire occurrence.

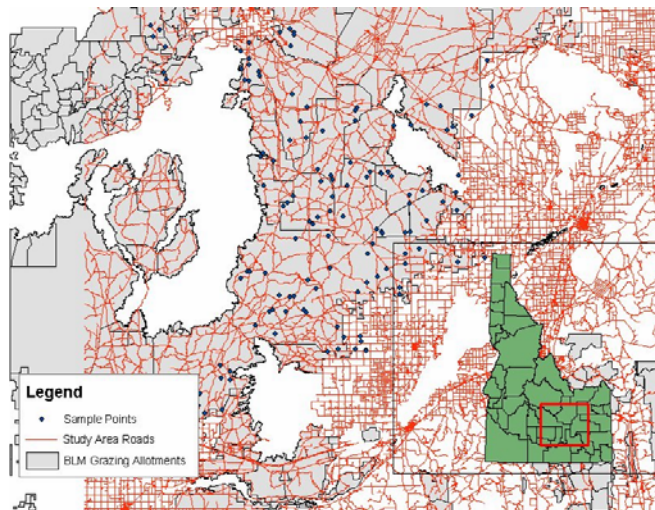


Figure 1. Map of the study area with sample points and road network.

METHODS

Experimental Design

Using ArcGIS 8.1, 129 points were randomly generated across the study area. Each point had to meet the following criteria: ≥ 70 meters from a road (to avoid edge effects) and ≤ 1000 meters from a road (to aid researchers in navigating to sample points on foot).

Sample points also had to fit our experimental design sampling strata regarding fire and livestock grazing treatments. Sample points were distributed over areas with no fire, one fire, or multiple fires, (between 1939 – 2001), and areas of livestock grazing and no livestock grazing.

Fuel Load Estimation

Fuel load estimates were made following BLM GIS Mapping Standards (BLM, 2001). Visual observations of an approximately 900 m² area centered over the sample point were used to make ocular estimates of:

- ◆ Assessment of the primary fuel structure of the area. (e.g. barren/rock, > 61 cm brush, short grasses)
- ◆ Assessment of the secondary fuel structure of the area. (e.g. barren/rock, > 61 cm brush, short grasses)
- ◆ Percent estimate of the fuel loading for wildfire fuels > 7.62 cm in basal diameter.
- ◆ Percent estimate of the fuel loading for wildfire fuels < 7.62 cm in basal diameter.
- ◆ Assessment of the presence of live fuels within the area.
- ◆ Estimate of the average height of all fuels.
- ◆ Estimate of the average depth of the duff component. (Duff, for this purpose, is defined as the decaying organic layer above the mineral soil.)
- ◆ Estimate of the average depth of the litter component of the stand. (Litter, for this purpose, is defined as needle cast, shed leaves and other shed vegetation matter above the duff layer.)
- ◆ Estimate of percent bare ground. (Bare ground is defined as exposed soil and rock and not covered with any vegetation, dead fuels, duff or litter.)
- ◆ Estimate of percent shrub cover.
- ◆ Estimate of the average shrub height of the big sagebrush plants in the area.
- ◆ Assessment of the current overall health of the shrub component (Decadence). (Only sagebrush shrub species were taken into consideration.)
- ◆ Estimate of percent grass cover.
- ◆ Estimate of percent forb cover.
- ◆ Estimate of percent cheatgrass cover.
- ◆ Estimate of average grass/ forb height. This includes the herbaceous and graminoid components of the area.
- ◆ Estimate of percent vegetation that would be removed due to an “average” fire. (We assume low fuel moisture, 80 degree day, 20% relative humidity, and 10 mph winds.)
- ◆ Estimate of rate of spread of an “average” fire. (We assume low fuel moisture, 80 degree day, 20% relative humidity, and 10 mph winds.)
- ◆ Assessment of the relative degree of grazing (domestic and wildlife).
- ◆ Assessment of previous fire evidence such as charcoal marks or fire scars.

Estimates were made based on field training for species identification and fuel load estimation instructed by Brandon Brown (BLM), Bryce Griffith (BLM), and Steve Pokovich (Consultant, Shoshone, ID). Glenn Burkhart (BLM) coordinated training.

Trimble Geo-Explorer II GPS receivers were used to acquire the sampling point location and record the above attributes data in a data dictionary. Approximately 50 positions per sample point were collected every 5 to 10 seconds to improve the accuracy of each location.

Forage Measurement

Data were collected to estimate available forage using a 0.44 m² circular hoop. The hoop was blindly tossed into each of four quadrants (NW, NE, SE, SW) centered over the sample point. All forage material within the hoop were clipped and weighed (+/- 1 g). All forb species and all grass species (except cheatgrass (*Bromus tectorum*)) were considered forage. The measurements were then used to estimate forage amount (lbs/acre) and animal units (AU/acre).

In addition to forage clipping, visual obstruction was collected to explore an alternative forage estimation method. Visual obstruction was measured using a graduated Robel pole marked with alternating 2.54 cm width bands of silver and black. The bottom of the pole had a 25 cm spike, which allowed it to stand free once the spike was pushed into the ground (Robel et al, 2000). The pole was located 10 paces (approximately 10 m) from the sample point in a 45° bearing. Visual obstruction readings were taken from each of four cardinal directions (N, E, S, W) at a distance of 4 m with the reader's eye at an approximate height of 1 m (Robel et al, 2000). The top band totally obstructed by forage was recorded for each reading.

Other Vegetation Characteristics

GAP Analysis

Using a list of vegetation types defined by the Idaho GAP 2 dataset (2000), the observed primary vegetation type that best described the sample point was recorded.

Big Sagebrush (*Artemisia tridentata* spp.) Age Estimation

Maximum stem diameter (+/- 1 mm) of big sagebrush plants within the first 250 mm of stem height was measured. Four samples were taken at each sample point, one at each quadrant (NW, NE, SE, SW) of the sample area. The big sagebrush plant nearest the plot center within each quadrant was measured. The age of each big sagebrush plant was estimated using a modified linear regression model ($6.1003+0.5769[\text{diameter}]$) developed by Perryman and Olson, 2000.

Photo Points

Digital photos were taken using an Olympus D-360L in each of 4 cardinal directions (N, E, S, W) from the sample point.

RESULTS

Fuel Load Estimations

Primary and Secondary Fuel Models

Short grasses, barren/rock, and > 61 cm brush were the dominant primary fuel models found in the study area (98 %). Secondary fuel model was typically barren/rock or short grasses (77 %).

< 7.62 cm Diameter Fuels and \geq 7.62 cm Diameter Fuels

Estimation of fuel load (kg/hectare) with basal diameter < 7.62 cm were low. More than 95 % of the sample points were estimated to have < 3 tons/acre. Fuel loads with basal diameter > 7.62 cm were low as well. Eighty percent of sample points were estimated as having < 3 tons/acre.

Average Duff and Litter Depths

Seventy-eight percent of sample points had a duff layer 2.54 – 3.81cm with no points having a mean duff depth > 7.62 cm. Litter depths were never measured > 7.62 cm with a majority (89 %) of the mean litter depths measured at < 2.54 cm.

Percent Bare Ground, Forb, Grass, and Shrub Cover

The percent bare ground was estimated as > 25 % at 71% ($n = 92$) of sample points. Forb Cover was rarely ($n = 7$) > 25 % cover. Seventy-six percent of the sample points were estimated to have < 5 % forb cover. A majority of sample points ($n = 105$) had a percent grass cover > 26 %. There were no sample points without grass species. In particular, cheatgrass, a non-native invasive species, was the dominant plant at many sample sites ($n = 20$). Percent cover of cheatgrass ranged from 0 - > 50%. Percent shrub cover was the most variable vegetation type.

Mean Shrub, Grass, and Forb Height

Mean shrub height was rarely ($n = 5$) > 91 cm (~3 ft). The majority ($n = 69$) was 30 – 91 cm. Sixty-six percent of sample points had a mean forb and grass height < 7 in.

Fire and Grazing Evidence

Fire was evident in 65 % of sample points and 69 % of sample points showed evidence of grazing. Thirty-six percent and 31% of sample sites had signs of light grazing and heavy grazing respectively.

Big Sagebrush Age Estimation

The mean age of big sagebrush plants was 38.8 yrs ($n = 348$). The minimum age was 7.9 yrs. and maximum age was 92.6 yrs.

Forage Measurements

Using AUM Analyzer software (Sheley, 1999), forage amount and available Animal Units (AU) were calculated for all sample points. Mean forage was 87.8 kg/hectare and mean AU was 0.097 AU/acre. The mean visual obstruction reading was 3.81 cm.

DISCUSSION

Collection of field data began July 4, 2001 and concluded August 8, 2001. Initially, our study had only 114 randomly generated sample points but after further review, these points were not meeting our experimental design criteria. Therefore, an additional 15

points were randomly generated and sampled allowing us to better meet our criteria (table 1).

Table 1. Stratification of sample points collected during the summer of 2001.

Treatment	Fires			Total
	0	1	>1	
Grazing	17	14	20	51
No grazing	33	28	17	78
Total	50	42	37	129

Fuel Loads Estimations and GAP Analysis

The large ranges recorded as interval data for percent cover (e.g. 1 – 25 %, 26 - 50%, >51%) may not accurately describe the vegetative community at the sample point. For instance, percent cover could only be recorded at very high (>51%). At some sample points, cheatgrass was clearly > 75%. An area of 75% cheatgrass would appear to be a highly infested while a moderately infested are could be 51 % cover. However, to accurately assess percent cover, a finer graduated, more diagnostic approach will be needed rather than ocular estimates.

GAP vegetation type observations may be too specific to accurately represent these areas. For instance, a sample point may be recorded as big sagebrush when 40 percent cover is big sagebrush but the remaining 60 percent are bare ground with bunchgrasses. Two methods that could improve agreement are; 1) record secondary habitat types or 2) increase the number of habitats to include mixed habitat (e.g. big sagebrush with short grasses).

Estimates of fuel load of plants with basal diameters < 7.62 cm and \geq 7.62 cm seemed low (< 3 tons/acre). Fuel loads were not recorded > 3 kg/hectare even in areas with larger, older big sagebrush plants. Further analysis may reveal that this is significantly correlated to percent bare ground and the grass types (rhizomonous or bunchgrass) present at the sample points. However, BLM fuel load guidelines are also used for forested areas which would have higher values for \geq 7.62 cm basal diameter fuels. This suggests that a more graduated characterization of fuel loads specific to Sagebrush Steppe communities may better describe the fuel loads in our study area. High values for < 7.62 cm fuels would be expected in areas of rhizomonous tall grasses and forbs. This suggests that fuel load models should be re-evaluated and sub-divided into additional models for particular vegetation types such as sagebrush-steppe.

Forage Measurements

Southeast Idaho experienced severe drought during the spring and summer of 2001 and our low forage measurement seems to support this. The visual obstruction reading (mean = 3.81 cm) suggests that forage is extremely limited across the study area. This may also indicate our method of measurement is not conducive for bunchgrass communities where bare ground cover is typically high (>40%). Benkobi et al (2000) found visual obstruction method conducive for Nebraska sandhills which consisted of mostly rhizomonous species of grasses thus allowing for readings > ours. Many sample

points had readings = 0 for this measurement because the nearest bunchgrasses would be inches to feet away and not obstructing the view of the pole in one of the cardinal directions from the reader. With rhizomonous species, there is an increased likelihood that grasses would be obstructing the view of pole in all directions. We believe the percent bare ground at each sample point may be a factor in this measurement. Vegetation in our study area included bunchgrasses with high percent bare ground (>40%), which may not be applicable for these methods.

A low visual obstruction average seems to coincide with low forage availability (0.097 AU/acre). Since both methods have low values, this correlates intuitively with a drought year where precipitation has limited forage growth.

Big Sagebrush Age

Big sagebrush age calculations reveal that the mean age of big sagebrush is 38 years with a minimum of 7.9 years and maximum of 92 years. We believe the minimum value (min = 7.9 yrs) may be overestimated and questions the validity of our modified linear regression model. A young big sagebrush plant could have a diameter of 1 mm and, based on our calculation, it would be nearly 6 years old. Our model may have a bias towards older big sagebrush and may not be an accurate calculation of age for young big sagebrush plants.

The dial-caliper had a maximum caliper width of 150 mm. When big sagebrush plants had diameter > 150 mm, the value was recorded as "150+" ($n = 18$). Further, 150 mm diameter plants are estimated to be 92 years of age. This suggests these plants have not experienced an intense fire in over 92 years.

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