The Interaction of Fire, Vegetation, and Large Mammalian Herbivores on Ecosystem Processes in Yellowstone National Park

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✦ Introduction

There is considerable evidence that interactions among fire, large mammals and vegetation exist in Yellowstone National Park. These interactions are likely complex, and discerning their nature will provide valuable information about basic ecosystem processes in the Park. The fires of 1988 have given us an excellent opportunity to evaluate potential interactions and consequently; provide additional information to resource managers regarding the importance of these factors in ecosystem dynamics.

✦ Objectives

The objectives of the first field season were as follows:

1. To select study sites
2. To collect preliminary data on standing crop and soil nutrients in burned and unburned areas
3. To establish temporary exclosures in each study site

✦ Methods

The 1990 field season began the first week of June and lasted until September 17. Selection of study sites in burned and unburned areas was undertaken during the month of June using aerial photographs and topographic maps. These areas then were reconnoitered from the ground. The most favorable sites were selected. A total of three sites were chosen encompassing summer, transitional and winter ranges of the primary large herbivores in the Park: Hellroaring Slopes (winter range), Swan Lake Flat (transitional range) and Hayden Valley (summer range). The sites are approximately 1.6-3.2 km from roadways and essentially hidden from heavy use hiking trails.

The three study sites each contain paired sampling areas in burned and unburned zones. The sampling areas in each burned/unburned zone are as similar as possible with respect to vegetation, aspect, slope, elevation and burn contiguousness. The sampling areas are sagebrush steppe except for one additional area in Hayden Valley which is dominated by sedge. Thus, there are a total of eight sampling areas.

Following site selection, peak standing crop was estimated in each of the sampling areas, except for the Hayden Valley sedge area. This site was included in the study design after peak standing crop had passed. Standing crop was measured using the point intercept method, which provides an accurate, nondestructive method of measuring standing crop. Eight, 0.5 m^2, quadrats were randomly located and sampled by passing 50 pins through the vegetation and counting the number of pin contacts for each species. One quadrat was clipped and the vegetation weighed to estimate the accuracy of this technique.

Vegetation samples were also collected in each sampling area for possible future nutrient analyses. Ten to twelve of the most common species in each sampling area were clipped in several random locations around the area until approximately two grams were obtained. The samples were placed into paper bags, air dryed and transferred into plastic bags for transport back to Syracuse University.

Nitrogen mineralization was evaluated in burned and unburned areas by measuring the difference of available nitrogen concentration over a 30 day period. This was done by extracting the soil with a 4 cm diameter stainless steel pipe, then placing 20 cm lengths of 4 cm diameter PVC pipe in the hole made by the pipe. The soil from the steel pipe then was put into the PVC pipe in the order it was extracted from the ground and subsequently left in the ground for 30 days. At the time of mineralization tube installation, a soil core was taken outside the tube to measure the initial concentration of nitrogen. The soil cores, as well as the soil in the mineralization tubes, were separated into three depths (0-5, 5-10, 10-20 cm), and placed in plastic bags until extraction. A total of five mineralization tubes and corresponding soil cores were taken in each sampling area.

Each soil sample was weighed and placed into three separate plastic bags. the first bag was used to determine the percent water of the sample, and the other two bags were used for separate soil extractions. The first extraction was done with KC1 to remove the available nitrogen, and the second extraction was done with Mehlich solution to remove all other mineral nutrients from the soil. Both extractions were filtered into plastic vials and returned to Syracuse University for analysis.

Temporary exclosures were flown to the study sites in early September. The exclosures were constructed with four 2x2 m panels made of rebar and wire. Five exclosures were constructed in each of the sampling areas, except for the Hayden Valley sedge area that received three, and were placed approximately 10-15 m apart.

✦ Results

Analysis of the standing crop and soil samples is incomplete.

✦ Conclusion

The primary objectives of this first field season have been achieved. Preliminary standing crop, nitrogen mineralization, and mineral nutrient data have been collected. Temporary exclosures are in place so that sampling can begin immediately in the spring. Data collected in 1990 will enable us to determine whether there are general differences in vegetation productivity and diversity between burned and unburned areas, and whether such differences may be attributable to soil nutrient concentrations. Herbivory data collected during 1991 from established exclosures will provide additional information on how fire, large mammals and vegetation interact in Yellowstone National Park.