An efficient sampling protocol for sagebrush/grassland monitoring

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Keywords: Random sampling, digital photography, GPS unit, protocol.

Introduction

Rangeland scientists and quantitative ecologists have developed numerous methods and monitoring techniques that can be used for vegetation sampling (Barbour *et al.* 1987). The methods used to position samples (transects, quadrats, lines, and points) vary and can be classed as selective, capricious, systematic, or random. One of the prerequisites for valid statistical inference is that samples are taken randomly. A random sampling procedure implies that all elements or units of the population being studied have an equal chance of being represented in the sample. It also implies that selection of an element or unit does not influence the chance of other units being sampled. Data that is collected using random sampling procedures can be used to compare attributes of different populations or sites such as vegetative cover, density, production, growth rates, etc. This paper suggests a random sampling protocol that can be easily applied in the field for sagebrush/grassland monitoring.

Material and Methods

Our protocols typically employ a monopod or pole with a mounting head which allows us to point a digital camera vertically downward from a fixed height (Louhaichi *et al.* 2010). Also attached next to the camera is a continuously recording (1 Hz) WAAS enabled GPS unit (Fig. 1). This combination of instruments allows us to take high-resolution, vertical images from between 1.5 m and 5.0 m above the sample plot (Booth *et al.* 2004). The higher the camera, the larger the ground coverage and coarser the resolution. Advances in digital imaging technologies have compensated for the loss of resolution and modern cameras have sensors that can capture images with a pixel count of 5784 x 3861, which translates to a ground pixel resolution of 1mm for an image covering 5.78 by 3.86 m. The height, species list, and reference photos are completed in field using a pre-determined sampling pattern for each ecological site (Fig. 2 and 3).

The data collection process can be divided into a series of steps in two operations: field (Fig. 4) and office (Fig. 5).

Results and Discussion

Since photographs can be taken quickly, many quadrats can be photographically sampled during a workday. It is not

Figure 1. Digital charting apparatus.

Figure 2. Landscape photo is taken (left) then reference photographs are taken of plants that are identifiable (right).

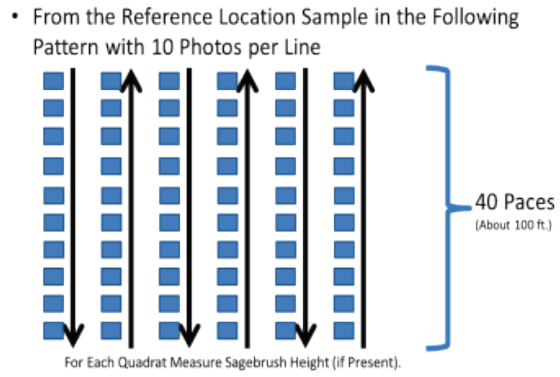

Figure 3. Sampling pattern used within an ecological site.

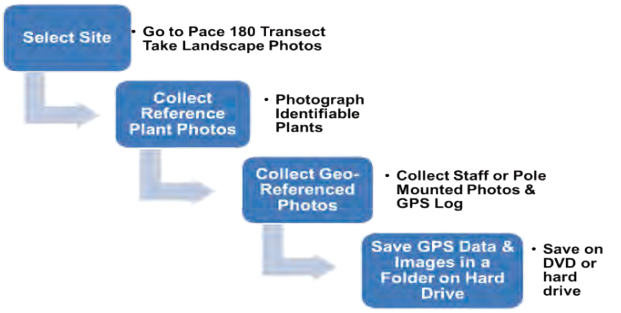

Figure 4. Diagram of a field protocol for collecting digital charting information that can be used for random sampling.

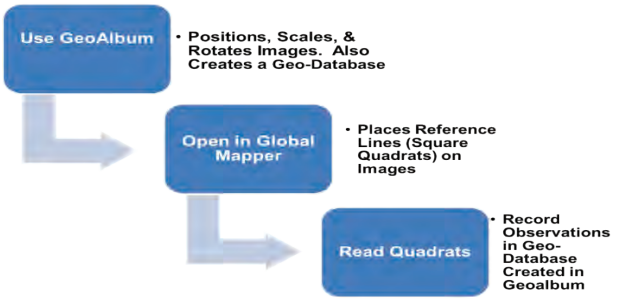

Figure 5. The office process involves positioning, rotating, and scaling images and saving them as geo-registered bitmaps.

unusual for us to sample 4 quadrats (plots) per minute once we are at a site and set up in the field, providing the area being sampled is level and samples are 2 to 4 paces apart. With low staff sampling, 60 images provide approximately 150 m^2 of ground that is photographed. If 25 samples of 0.25 m^2 are randomly chosen from the complete photographic record, we have randomly sampled less that 5% of the total area photographed. Once geo-referenced photographic samples are taken, they can be examined, read, and/or processed (Fig. 6).

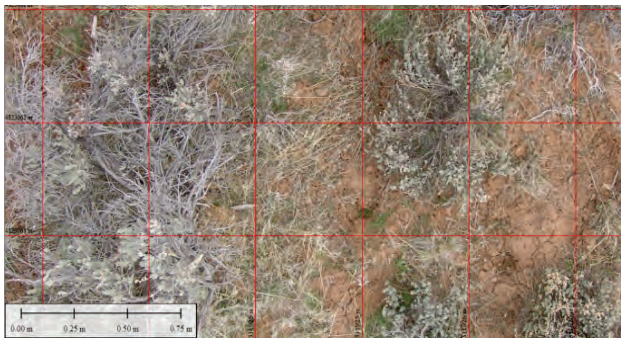

Figure 6. Example results from digital sampling of photo quadrats on a low sagebrush/perennial grasses site.

Conclusions

The proposed digital charting protocol can be used to monitor perennial grass, forb, shrub, and weed cover and density as well as plant species composition change over years, the presence of distinctive plants, and mortality of specific perennial plants. It can also be used to evaluate the intensity of grazing, presence of insect pests, and the effectiveness of herbicide treatments. Because field sampling is so fast, many sites can be sampled in the same phenological stage, encouraging uniformity and consistency of collected information.

References

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