Describing Greater sage-grouse (*Centrocercus urophasianus*) Nesting Habitat at Multiple Spatial Scales in Southeastern Oregon

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SUMMARY

Plant community structure associated with greater sage-grouse (*Centrocercus urophasianus*) nesting habitat has been well described at the plot scale immediately around the nest, frequently less than 200 ft^2. However, less is known about nesting habitat attributes at the landscape scale. The purpose of this research was to characterize sagebrush habitat structure surrounding nest sites at multiple spatial scales and to compare these with random locations. Nest site coordinates were obtained from1995 to 2003 as part of a long-term sage-grouse reproductive study at Hart Mountain National Wildlife Refuge in southeastern Oregon. In the same region, plant communities were mapped within a 76,000-acre area (6.25-mile radius) from a centralized lek using aerial photography and computer mapping tools (ArcGIS 9). At each nest site, patch (a distinct plant community type) size, shape, distribution, composition, and density were described for six different spatial scales ranging from 82 to 3280 ft radiuses surrounding the nest. Similar measurements were collected at random sites. Although differences were small at fine scales (80 ft), patch density and richness were greater around the nest than at random points as scale increased. Habitat heterogeneity became an important component of broad-scale habitat selection. These data suggest that plant community structure associated with greater sage-grouse nest sites at the small scale is a mosaic of plant communities that vary in structure and composition. This implies that habitat assessment at fine scales may not be adequate to accurately predict sage-grouse nesting habitat potential.

INTRODUCTION

Greater sage-grouse depend throughout the year on sagebrush (*Artemisia* spp.) communities for foraging, nesting, and hiding cover. Most studies report a positive relationship between sage-grouse nesting success and adequate sagebrush structure (Gregg et al. 1994, Connelly et al. 2000). A significant amount of work has been done to determine what characteristics in a sagebrush community are most important for successful sage-grouse nesting. This includes studies used in developing the guidelines for assessing sage-grouse nesting requirements across the species' range. Most of the results were determined from small-plot field measurements placed directly around the nest (7.5-ft radius or a 200-ft^2 area surrounding nest site locations). However, concerns and controversy have developed in applying small-scale habitat preferences and requirements across large heterogeneous landscapes. Requirements for structure and composition are frequently not entirely met, particularly in the more arid sagebrush communities characterized by Wyoming big sagebrush (*A. tridentata* spp. *wyomingensis*) (Davies et al. 2006).

At the landscape scale, sagebrush stands can exhibit significant heterogeneity in both community structure (spatial arrangement of plant cover and height) and composition of different plant life forms (shrubs, grasses, and forbs). According to Kie et al. (2005), the arrangement of these plant life forms in communities can influence the distribution of animal species. Past research suggests sage-grouse select small areas of vegetation structure for nesting that often do not represent the average structure of vegetation in the area surrounding the nest. For example, sagebrush cover may be higher immediately adjacent to the nest than the average cover representing the surrounding plant community or landscape. Therefore, applying these requirements (e.g., nest patch) to large heterogeneous landscapes becomes a major challenge.

Connelly et al. (2003) recognize the value of remote sensing and Geographic Information System (GIS) for digitizing plant communities and measuring the size and juxtaposition of habitat patches (vegetation units that are composed of uniform and relatively homogeneous assemblage of species growing at a particular point in time and space with a distinct boundary). They also suggest that patch size, habitat quality, connectivity, patch edge, and distance between patches be measured to determine relationships between plant community structure and habitat selection preferences. The purpose of this study is to quantify patch density and richness surrounding nest locations at multiple spatial scales and to relate these patterns to habitat assessment at fine-scales.

METHODS

Between 1994 and 2003, 260 collared Greater sage-grouse hens were tracked to their nest site using radio telemetry. At the nest site, a coordinate position was obtained for that location using Global Positioning System (GPS). During 2005, high resolution aerial photographs (digital orthophoto quadrangles, DOQ) were used to delineate distinct plant community types across the study site. In 2006, the accuracy of mapping was increased by including 3.3-ft resolution NAIP color images for patch delineation. We defined patch as a plant community type with a distinct boundary separating it from adjacent community types of different composition and structure. Plant community types in this study were characterized by the dominant overstory shrub species). They included low sagebrush (*Artemisia arbuscula*), Wyoming big sagebrush, mountain big sagebrush (*A. tridentata* ssp. *vaseyana*), bitterbrush (*Purshia tridentata*), and low sagebrush-mountain big sagebrush and low sagebrush-bitterbrush where patches were too small to map (Fig. 1). In addition to dominant or co-dominant shrub community types, tree cover was mapped for western juniper (*Juniperus occidentalis*), curl-leaf mountain mahogany (*Cercocarpus ledifolius*), and quaking aspen (*Populus tremuloides*).

Figure 1. Highly preferred greater sage-grouse nesting habitat on the Hart Mountain Wildlife Refuge. The majority of vegetation shown is a complex of two plant community types, mountain big sagebrush and low sagebrush, with small inclusions of mountain mahogany and aspen.

Nest site locations were overlaid onto the vegetation map. In addition to the actual 260 nest sites, an equivalent number of points were randomly located across the vegetation map to characterize vegetation for the study area. At each point (both nest and random or non-nest locations) the spatial pattern and composition of plant community types surrounding the nest and random points were described for 6 different scales, ranging from 82 to 3280-ft radius from the point (Fig. 2). The 82-ft radius scale (0.5 acres) was designed to assess habitat structure at fine-scales, 820-ft plots (48 acres) at moderate scales, and 3281-ft radius (775 acres) at broad scales. Measurements included 1) the size and shape (or amount of edge) of each community type, 2) patch density, and 3) composition of community types. Plant community patch density is defined as the total number of plant community type patches that occurred in the radial area from a particular point. Patch richness represents the number of different community types within a particular radial distance from a nest site or random point. T-tests were conducted to test whether the mosaic of patches were more complex surrounding nests sites than random sites.

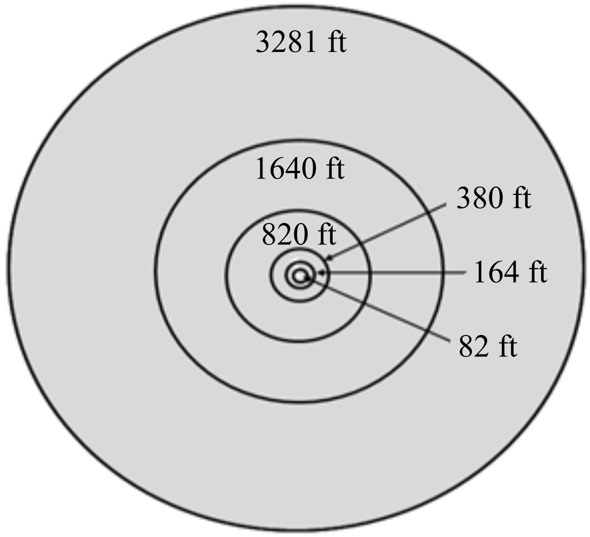

Figure 2. Plot dimensions representing different scales at each sage-grouse nest site and random point.

RESULTS

Sage-grouse nest sites were located in areas that were more diverse than the overall landscape. This included the number of distinct vegetation patches and the number of different patch types at each scale that we analyzed. The magnitude of the difference between nest and random points increased with scale (Fig. 3). Greater complexity of community type patch shape and varying sizes surrounding nesting points compared to non-nesting points was more consistent as scale increased. Results of the t-test analysis showed that patch differences between actual and random nest sites was significant at all spatial scales we examined. The level of significance increased as scale increased. Additional analyses are currently being conducted and will be available soon.

DISCUSSION

Greater sage-grouse selected nest sites with greater plant community heterogeneity, in particular at moderate (over 48 acres) to broad (over 375 acres) spatial scales. In summary, greater sage-grouse hens selected areas with greater levels of plant community diversity (e.g., mosaic of patches containing low sagebrush, mountain big sagebrush, bitterbrush community types) compared to areas with larger patch sizes that results in less diverse habitat. A diverse habitat can provide additional resources (i.e., greater forage availability such as forbs and insects) that may not be available in a more homogenous environment. Studies indicate that nesting habitat occurs most frequently in big sagebrush-dominated communities; however, the juxtaposition of these communities to other plant community types (i.e., low sagebrush) and the complexity and composition of the surrounding ecosystem should also be considered when managing greater sage-grouse populations. In addition to exploring the usefulness of using one or more landscape attributes (i.e., patch density, size, composition, etc. or topographic features) in predicting nest site habitat, the primary question that we pose is what scale of analysis provides the highest predictive power. We are currently addressing this question.

MANAGEMENT IMPLICATIONS

To effectively conserve greater sage-grouse populations, methods are needed to accurately and efficiently assess habitat requirements. We suggest that land management be applied at the landscape scale, where plant community heterogeneity can be more accurately identified.

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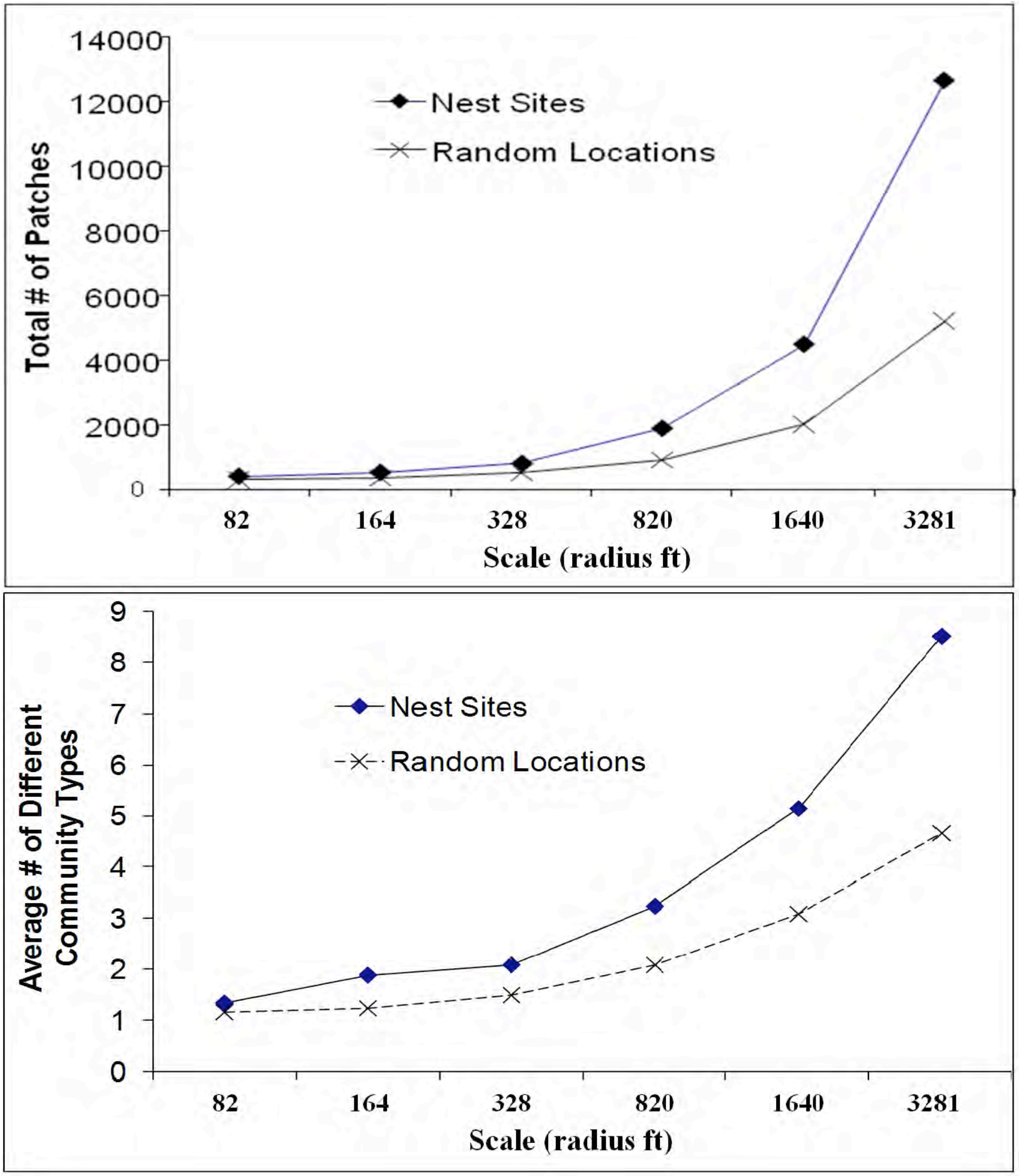

Figure 3. The number of total distinct community patches and average number of different community types surrounding both nest and non-nest (random) points at six different scales radiating from the point.