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Sage-Grouse Habitat Monitoring: Daubenmire versus Line-Point Intercept

By Eric Thacker, Terry Messmer, and Beth Burritt

On the Ground

- Evaluation of range/habitat projects for sage-grouse require careful monitoring to measure their impact.
- Daubenmire canopy cover and line-point intercept did not yield similar results.
- As herbaceous canopy cover increased, the differences between the cover estimates increased.
- Adoption of both techniques by both groups may be the only feasible solution since institutional constraints limit either group from changing monitoring techniques.

Keywords: monitoring, habitat, canopy cover, methods comparison, sage-grouse.

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The Problem

Herbaceous cover estimates obtained using the line-point intercept and Daubenmire canopy cover methods may not be comparable when monitoring the habitat of greater sage-grouse (***Centrocercus urophasianus***; Fig. 1). Monitoring sage-grouse habitat is important because sage-grouse populations have been declining over the past 5 decades [12], and habitat loss and degradation have been cited as major factors in this decline [1,2]. An important component of sage-grouse management is the evaluation of herbaceous vegetation response to projects implemented to improve habitat quality [3].

Sage-grouse researchers recommended using standardized methods to assess sage-grouse habitat quality [3]. This would allow valid comparisons among years, areas, and populations [3]. Sagebrush (***Artemisia*** spp.) communities provide escape cover and forage for sage-grouse, so assessing vegetation parameters related to escape cover and forage is critical in assessing sage-grouse habitat [3]. Common measurements used to describe sage-grouse habitat include cover, density, height, frequency, and visual obstruction [3]. Canopy cover of shrubs and herbaceous vegetation is important because these are used as indicators of habitat quality [3]. In addition, canopy cover of forbs has been used to estimate the abundance of plants used by sage-grouse for food [3,8].

Connelly et al [2,3]. described three methods for assessing herbaceous cover (line transect, point-intercept, and quadrat). They suggested that all three methods were adequate, with the point-intercept and quadrat methods being the most time-efficient. They also noted that the Daubenmire canopy cover method was used more frequently by biologists studying sage-grouse to assess habitat conditions.

The Natural Resources Conservation Service (NRCS) has established sage-grouse habitat management as a conservation priority. Subsequently, the NRCS has provided cost-share to landowners through various incentive programs such as the sage-grouse initiative for landowners who choose to implement conservation practices that benefit sage-grouse. The NRCS currently uses the line-point intercept method to measure vegetation conditions and response to management [9]. Herrick et al [9] recommended that the line-point cover method be used to determine soil, vegetation, rock, and litter cover as well as cover of biotic crusts.

The Daubenmire (Fig. 2) and the line-point intercept (Fig. 3) methods are commonly used to estimate the same vegetation parameters (percent of canopy cover) of differing functional groups (grasses, forbs, bare ground, etc.) [3]. However, because of the increased emphasis by the NRCS on cost-share programs to benefit sage-grouse, it is important to determine whether the two methods employed by the NRCS and wildlife biologists yield comparable results.

Floyd and Anderson [7] compared the line intercept, point-intercept, and Daubenmire canopy cover estimates and concluded that point-intercept was more time-efficient and yielded more precise estimates. However, they used point-intercept frames rather than line-point intercept transects similar to those employed by the NRCS [7,9]. Dethier et al [6]. also evaluated the point-intercept method and visual plot cover estimates in a laboratory simulation and concluded that visual estimates within subdivided plots showed fewer variations among observers and yielded closer cover estimates of the true cover. However, in [6], they did not use the cover categories [3], and their experiment was a laboratory simulation

Figure 1. Strutting sage-grouse (*Centrocercus urophasianus*) on a lek in northern Utah.

with frames that were 4 × 5 cm, making it impossible to determine how closely this simulation represented field conditions that have complex vegetation.

Wildlife biologists working with sage-grouse estimate vegetation cover using the Daubenmire canopy cover method, whereas NRCS range conservationists use the line-point intercept method to determine vegetation cover. Even though both of these methods were mentioned in sage-grouse monitoring protocols [3] as being adequate measures of sage-grouse habitat, they may not be comparable. The purpose of our study was to compare cover estimates obtained in a field experiment using Daubenmire canopy cover and line-point intercept methods.

Comparisons

We conducted our study in the Grouse Creek Valley in west Box Elder County, Utah. The vegetation in the study area consists mainly of sagebrush-steppe communities intermixed with grassy meadows and woodlands.

We used the line-point intercept and Daubenmire methods in 2008 to measure herbaceous vegetation at sage-grouse brood locations [3,9]. The techniques were used concurrently in vegetation transects established as part of ongoing research into sage-grouse habitat use. Vegetation sites were established at grouse locations. Vegetation data were recorded on four 10-m transects that bisect each other at the brood center, for a total of 40 m of transect at each location [4,11].

We estimated Daubenmire canopy cover of herbaceous vegetation using a 20-m × 50-m frame [5]. The frame was placed at 2.5-, 5.0-, 7.5-, and10-m marks along each of four transects, for a total of 16 frames per brood location [4,11]. We used five cover categories; each species or functional group received a number ranging from 1 to 6: 1 = 0–1% cover; 2 = 1.1–5% cover; 3 = 5.1–25% cover; 4 = 25–50% cover; 5 = 50–75% cover; and 6 = 75–100% cover [3,5].

We subsequently used the point-intercept technique [9] to measure vegetation along the same transects. We recorded 50 points per transect, for a total of 200 points per site. Line-point intercept data were recorded by dropping a pin (3 mm × 120 cm that had been sharpened to <1 mm) every 20 cm along the 10-m (1,000-cm) transect. The observer held the pin perpendicular to the tape on the top side (where the numbers meet the tape edge) and dropped the pin. The observer identified the species or plant functional group (perennial grass, forb, or annual grass) the pin struck or passed through as it was dropped. The observer recorded hits on herbaceous species, rock, litter, and bare ground (hits on shrubs were ignored). The tapes used for the transect lines were kept taut by using logging pins inserted through both ends and forced into the ground [9]. To avoid misclassification of individual species, we combined all species into respective functional groups; the functional groups included perennial grass, forbs, and annual grasses.

We calculated Daubenmire cover estimates by averaging cover for functional group across all frames for all transects at each location. Midpoints for cover categories were used to average percent of cover for functional groups [5]. We summarized line-point intercept data by totaling all hits along all four transects for each functional group and dividing the sum by the total number of points (200), yielding the percent cover for each functional group.

Mean differences and confidence intervals (CI) were calculated for each functional group by taking an absolute difference between line-point intercept and Daubenmire cover

Figure 2. Demonstration of the Daubenmire method in a high-elevation mountain big sagebrush (*Artemisia tridentata vaseyana*) community in northern Utah.

estimates at each brood location. Means and 95% CI were then calculated for the differences for each functional group across all brood locations.

We created scatter plots for each functional group to view data characteristics. Scatter plots were created by plotting point-intercept cover estimates (y axis) against Daubenmire cover estimates (x axis) for each functional group. Each scatter plot was fitted with a one-to-one line, with an x and y intercept of zero. This line represented where values should be distributed if the mean differences equaled zero (i.e., if the methods yield the same cover estimates). The mean differences and CIs were then used to test for differences between the two methods. If the CIs overlapped at 0 for any functional group, the two methods were similar, but if the CI did not overlap at 0, the results of the two methods were statistically different.

In addition, we evaluated the impact that increasing cover estimates may have on mean differences for each functional group by separating the cover data for each functional group into four equal quartiles using point-intercept cover estimates (we arbitrarily chose line-point intercept cover). The mean differences were calculated for each of the four quartiles, and the results were then graphed to show the general trend of mean differences as cover estimates increased.

Are They the Same?

The results for perennial grass and forb cover were skewed above the expected value line, suggesting that point-intercept estimates yielded higher cover values than those obtained by

Figure 3. Demonstration of the line-point intercept method in a Wyoming sagebrush (*Artemisia tridentate wyomingensis*) community in southern Utah.

using the Daubenmire method. The scatter plot results suggest that differences between the two methods may increase as cover increases (Fig. 4).

Comparisons of the means of functional groups by sampling method suggest that line-point intercept yielded higher cover estimates than the Daubenmire (Fig. 5). This difference was more pronounced with perennial grasses. The results of the mean differences and 95% CI suggested that the cover estimates were not comparable (Fig. 6). As cover increased, the mean differences by methods also increased (Fig. 4).

Mitigating Differences

Our study demonstrates that the two sampling methods do not yield comparable estimates of herbaceous cover (Fig. 6). In addition, the variation in cover estimates increased as vegetation cover increased in all functional groups. Our results indicate that line-point intercept cover estimates were consistently higher than Daubenmire estimates (Fig. 5). There is no method to determine the actual cover values, so we cannot speculate about the accuracy of these methods.

Because the methods are not comparable, sage-grouse biologists and range conservationists need to find a compromise to mitigate the differences between these two methods. One way to reduce such controversies is to standardize methods for measuring the response to sage-grouse habitat management actions between NRCS and sage-grouse biologists. However, standardization may become problematic because it would require at least one agency to change its current method. The United States Department of Agriculture, Agricultural Research Service, Jornada Experimental Range in Las Cruces, New Mexico, has developed quantitative monitoring protocols in an attempt to standardize range monitoring and assessment [5]. These protocols have been adopted by both the NRCS and the Bureau of Land Management [10].

Sage-grouse biologists could simply use the line-point intercept method rather than the Daubenmire method. However, sage-grouse biologists have created a unified system of gathering biological data for sage-grouse [3] and have collected decades' worth of data using the Daubenmire method. If sage-grouse biologists adopted the line-point intercept method, it would render comparisons of future results to past results meaningless.

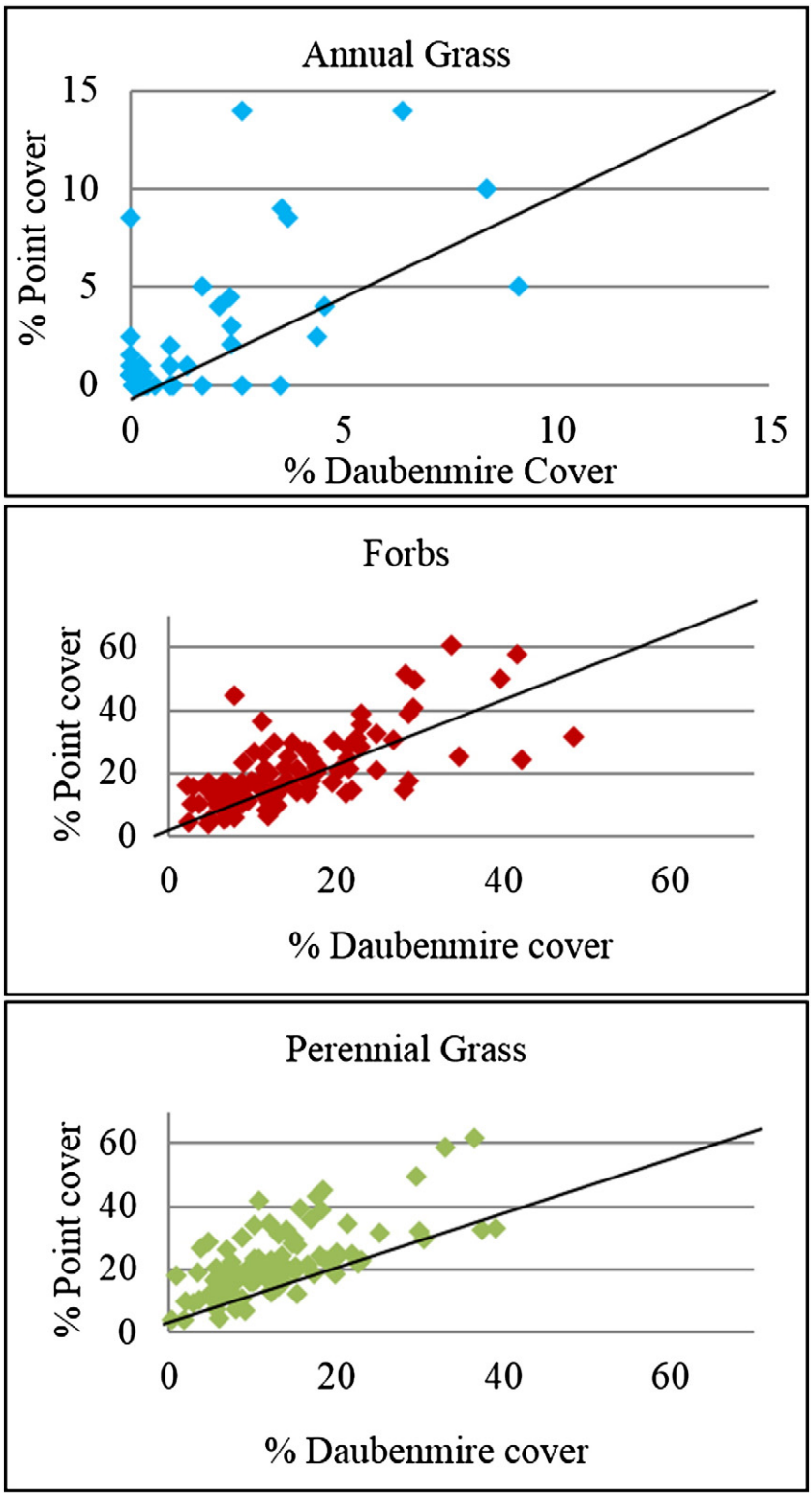

Figure 4. Scatter plots for each functional group (perennial grasses, annual grasses, and forbs). Plots were created by plotting line-point intercept (% point cover) and Daubenmire cover estimates (% Daubenmire cover). The line represents where the points should fall (predicted) if the two methods were similar.

We suggest that both groups collect both line-point intercept and Daubenmire canopy cover data for NRCS projects dealing with sage-grouse. This will increase the amount of time required to collect vegetation data and may increase the cost of data collection. However, we estimate it would require only 10 additional minutes at each sampling site for properly trained technicians (E. Thacker, unpublished data, Utah State University); additional training may require

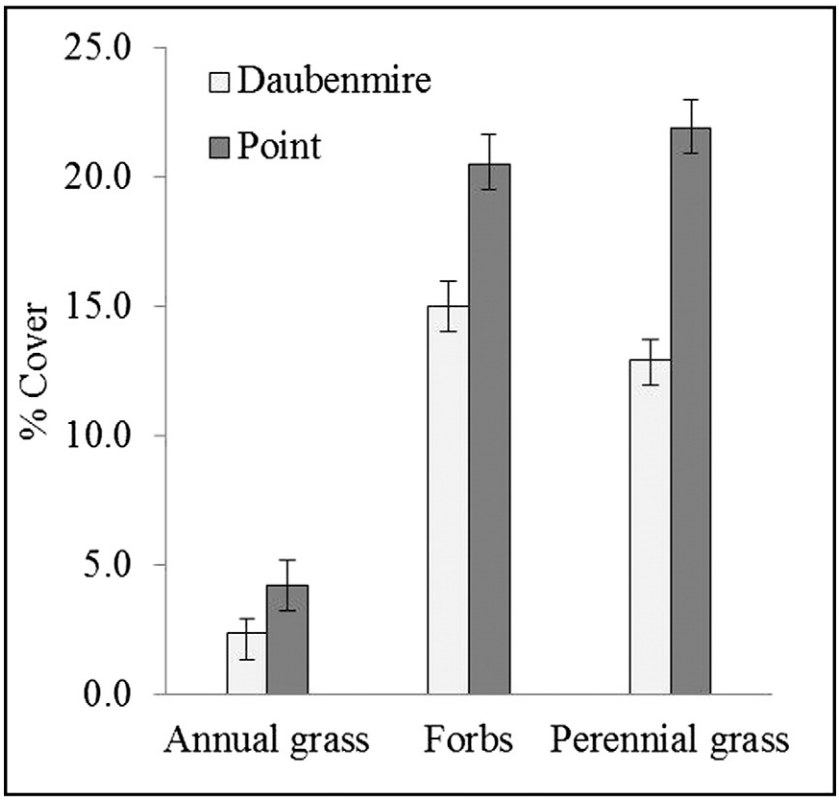

Figure 5. Daubenmire and line-point intercept cover estimates for functional groups in sage-grouse habitats.

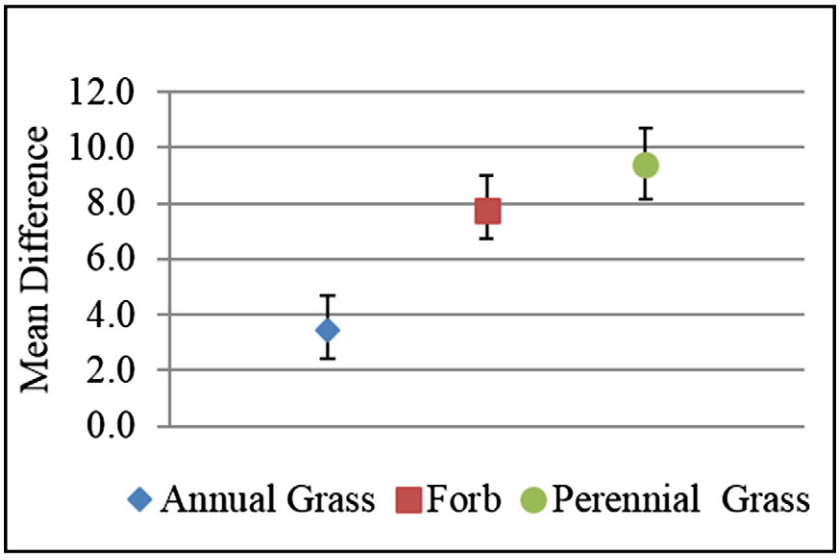

Figure 6. Mean differences between Daubenmire canopy cover and line-point intercept cover estimates for each functional group. Error bars represent 95% confidence intervals (CIs). If CIs were to overlap zero (the x axis), the methods would be considered to yield reliably the same response 95% of the time.

some additional costs for training crews to conduct both methods. Collecting both types of data would allow agencies to have comparable data.

Our study confirmed that herbaceous cover estimates obtained using the line-point intercept and Daubenmire canopy cover methods are not comparable. NRCS staff and wildlife biologists should consider using both methods when evaluating vegetation responses of cost-share projects, thus ensuring that data collected by biologists and NRCS staff are comparable when evaluating sage- grouse projects.

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Authors are Assistant Professor and Range Extension Specialist (Thacker, eric.thacker@usu.edu); Professor, Fisheries and Wildlife Extension Specialist, Quinney Professor for Wildlife Conflict Management, and Associate Director, Outreach and Extension (Messmer); and Extension Assistant Professor, Dept of Wildland Resources, Utah State University, Logan, UT 84322, USA (Burritt).