Natural Resources and Environmental Issues

Volume 16 *Shrublands: Wildlands and Wildlife Habitats* Article 34

2011

Comparing Vegetation Monitoring Methods in Shrublands: How Valuable is Grant's Method in Shrub Communities?

Matt M. Church

Mary I. Williams

Ann L. Hild

Ginger B. Paige

Comparing Vegetation Monitoring Methods in Shrublands: How Valuable is Grant's Method in Shrub Communities?

Matt M. Church[1], Mary I. Williams[1], Ann L. Hild[2], and Ginger B. Paige[1]

ABSTRACT

Faced with managing extensive rangelands, land managers need reliable monitoring methods. Grant and others (2004) proposed a monitoring method that uses a floristic classification of dominant vegetation and assesses species frequency. The method was developed in native grass prairies with limited woody vegetation and is designed to provide more efficient repetitive monitoring. Our objective for this study was to determine if Grant's method is useful in shrubland systems for a newly implemented baseline inventory and monitoring program. We conducted a study to compare Grant's method and its efficacy to more commonly used line-point intercept in grass and shrub alliances at Brown's Park National Wildlife Refuge, Colorado. In the summer of 2007 we conducted baseline inventory of vegetation characteristics on 39 permanent bottomland plots in six pre-determined grass and shrub vegetation alliances on the refuge. Within each plot, we monitored vegetation with line-point intercept and Grant's method on three 50 m line transects. We compare data collected using these methods from a grassland (smooth brome dominated) and a shrubland (greasewood dominated) alliance. Results of this study indicate that data collected using Grant's method is more variable than line-point intercept data in shrub systems. Bare ground was detected less using Grant's than line-point intercept; however, Grant's detected more herbaceous and invasive species overall than did the line-point intercept method. A complementary use of the methods for long-term monitoring is recommended that accommodates tradeoffs between incorporating detail versus efficiency of data collection efforts.

INTRODUCTION

Rangeland inventory and long-term monitoring allow land managers to detect changes and assess trends in rangeland resources. The initial data collection on a site is to develop a baseline inventory; subsequent monitoring is valuable for detecting changes and assessing trends over time. Baseline inventory provides both ecological and management information about the site. Effective monitoring practices enable managers to evaluate the effectiveness of their management actions and develop more appropriate management practices over time (Barker 2001).

There are a variety of vegetation and site characteristics that can be monitored and the methods differ in rigor and resource commitments. Furthermore, vegetation monitoring methods vary greatly depending on location, scale, and objectives. Plant species composition may be quantified using techniques that assess frequency of occurrence, cover, or density (Elzinga and others 1998). Herrick and others (2005a and 2005b) describe many of the commonly used rangeland monitoring methods. These include line point intercept and belt transects which assess percent cover and density of vegetation species. Grant and others (2004) proposed a monitoring method that uses a floristic classification of dominant vegetation and assesses their frequency. The method was developed in native grass prairies with limited woody vegetation and is designed to provide for more efficient repetitive monitoring on the same site.

Land managers, faced with managing and monitoring large areas of rangelands, are interested in time efficient but effective monitoring methods. We conducted a study to compare Grant's method and its efficacy to more commonly used monitoring methods, specifically the line point intercept method. The overall objective was to determine if Grant's method is useful in shrubland systems in a newly implemented baseline inventory and monitoring program. The methods are compared in both shrub and grasslands systems.

METHODS

Area of Study

The study was conducted in the bottomlands area of Brown's Park National Wildlife Refuge (BPNRW) in northwestern Colorado. BPNWR is located in the Upper Colorado River Ecosystem and includes a mixture of habitats from the Middle Rocky Mountains, Wyoming Basin, and Colorado Plateau (USFWS 1999). The refuge is comprised of 5445 ha of wetlands, riparian habitats, and uplands and provides habitat for 300 wildlife species including 68 mammals. This region is semi-arid, and receives approximately 24 cm of precipitation a year. Elevations at BPNWR vary from 1,632 to 1,889 m.

The bottomlands at BPNWR are dominated by dense stands of greasewood (*Sarcobatus vermiculatus*), rabbitbrush (*Chrysothamnus* spp.), perennial grasses and several

---

In: Wambolt, C.L. et al. comps. 2011. Proceedings – Shrublands: wildlands and wildlife habitats; 2008 June 17-19; Bozeman, MT. NREI, volume XVI. S.J. and Jessie E. Quinney Natural Resources Research Library, Logan, Utah, USA.
[1]Matt M. Church, Graduate Research Assistant, Mary I. Williams, Doctoral Research Assistant and Ginger B. Paige, Assistant Professor, Department of Renewable Resources, University of Wyoming, Laramie, WY
[2]Ann L. Hild, Professor, Renewable Resources Dept. University of Wyoming, Laramie. annhild@uwyo.edu

invasive plant species. Portions of the bottomlands are periodically flooded to provide habitat for migratory birds. Shrublands account for approximately 660 ha of the 1150 ha bottomland area. The refuge is currently implementing new baseline monitoring programs. Baseline inventory and long-term monitoring of the bottomlands are needed for the refuge to develop and assess their management programs.

Plot Layout

Thirty-nine to 55 m fixed radius circular plots were located on identified bottomland alliances on the refuge, spaced at least 250 m apart (figure 1). The center of each plot was marked and its location recorded with a global positioning system (GPS). Soil and vegetation characteristics were measured on three 50 m line transects arranged in a spoke design originating 5 m from the center of the plot. An azimuth direction (1° to 360°) for the first transect was chosen from a random number table and subsequent transects were placed at 120° intervals from the first transect. The six alliances monitored in the bottomlands at BPNWR include: alkali sacaton (*Sporobolus airoidies*) and inland saltgrass (*Distichlis spicata*) 5 plots, needlegrass (*Stipa* spp) -greasewood mix, 2 plots, wheatgrass mix (*Elymus* spp) 6 plots, rabbitbrush mix, 10 plots, bottomland black greasewood dominated areas, 13 plots and smooth brome (*Bromus inermis*) 3 plots. For this study we concentrated on the plots in the smooth brome and bottomland greasewood alliances.

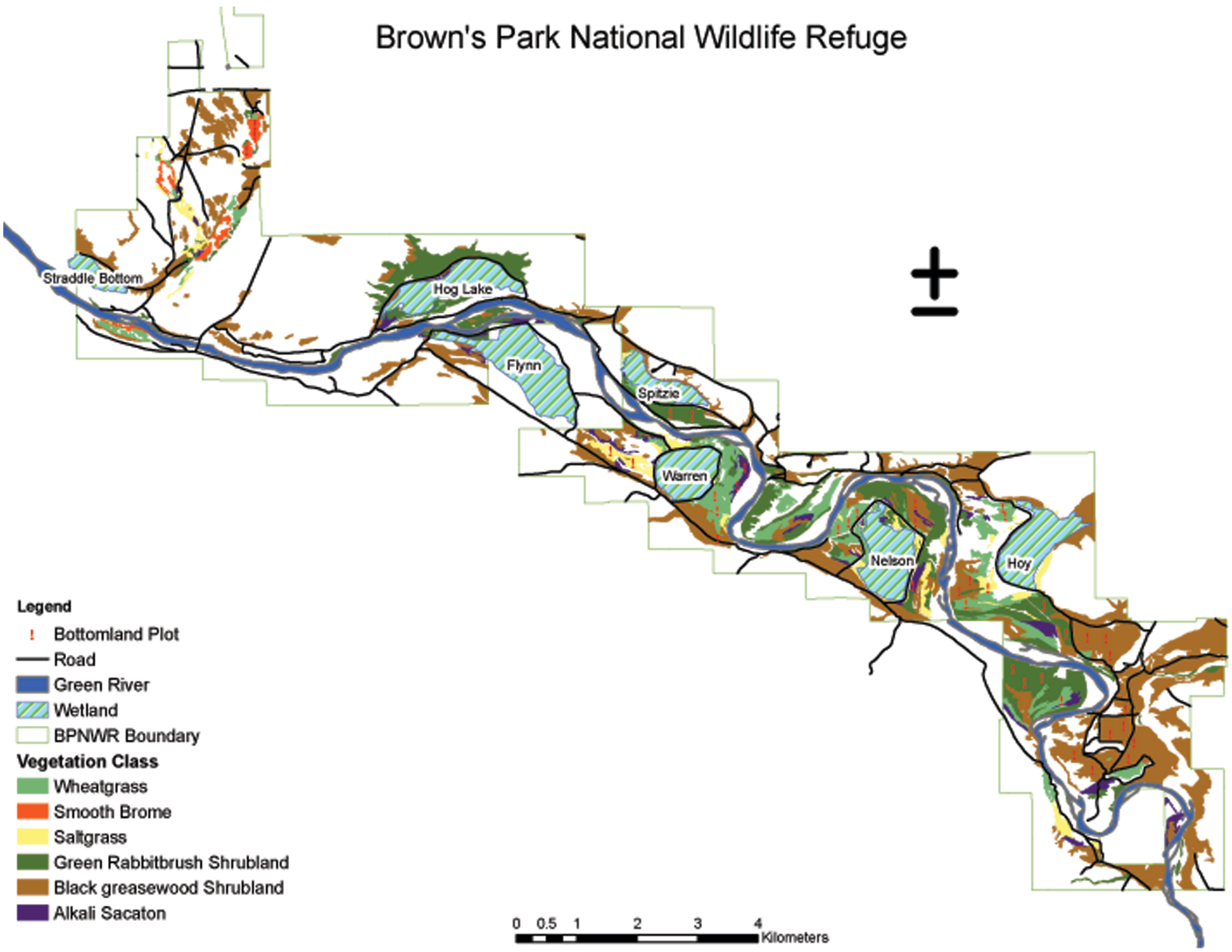

Figure 1—Bottomland study plots (39 to 100 m radius) were established within six vegetative alliances in bottomlands at Brown's Park National Wildlife Refuge, CO to initiate long-term monitoring. Monitoring data from the Smooth brome and greasewood dominated plots are used to compare monitoring methods.

Monitoring Methods
We monitored vegetation cover using both line-point intercept and Grant's methods on 3 plots in the Bottomland Greasewood alliance and 3 plots in the Smooth Brome alliance. Grant's method measured floristic characteristics on each 50 m line transect in a 0.1 x 0.5 m belt. A plant species was documented if it had greater than 10 percent abundance in each quadrat. Vegetation was recorded as frequency of occurrence and more than one species could be recorded in a quadrat. When no species had 10 percent or greater abundance within a quadrat, we recorded the quadrat as sparsely vegetated. More detailed description of the method is available (Grant and others 2004).

We used a modification of the line-point intercept (Canfield 1941) described by Herrick and others (2005b) to record vertical density measurements and total canopy and ground cover. Starting at the half-meter mark, and continuing every meter for 50 total points, we recorded cover data along each of the three 50 m transect lines within each plot. The first plant species intercepted (by a vertically dropped pin flag) and its height was recorded as top canopy; additional species at the same point were recorded as lower canopy in order of interception. A canopy species was recorded only once per point even if intercepted at more than one level. Ground surface was recorded as moss, rock (> 5 mm diameter), plant species base, litter or bare ground.

Method Comparison
Data from Grant's method are expressed as frequency of species occurrence, whereas line-point intercept data are expressed as percent cover. The data from the two methods cannot be compared directly because of these inherent differences. Grant data are continuous, with 100 quadrats along each line transect. Line-point intercept data are discontinuous with 50 distinct measurement points along each line transect. We recalculated the Grant data for a 0.1 x 1.0 m quadrat size. The recalculated counts for species were multiplied by two to result in percent occurrence. Recalculation of Grant transect data allowed for a comparable scale with the line-point intercept data which were collected at 1 m increments. We examined cover data of dominant shrub and grass species and bare ground from the shrubland and grassland alliances to compare the two methods. To determine the reliability of each measurement method within the two systems, we calculated the coefficients of variation (CV) for each plot. The CVs were analyzed to compare the variability of the two methods using analysis of variance (ANOVA).

RESULTS

Compared over all species, the CVs of line point intercept data were significantly less than the CVs of Grant measures (P < 0.05). More herbaceous species were detected by Grant's method in smooth brome and greasewood alliances (table 1). Bare ground was not as readily detected using Grant's method. Line-point intercept detected more abundant species but did not intercept less common species on the transects. Grant's method detected both abundant and less common species (such as VUOC, ELTR).

In the smooth brome alliance, the methods differ in their ability to detect bare ground under canopy cover (figure 2). The line-point intercept detected a small amount of bare ground in two of three plots; no bare ground was detected using Grant's method in the same plots. Smooth brome cover was recorded in each of the three plots using all methods; the amount detected was highly variable within and among the three plots regardless of the method used. Grant's detected less smooth brome with less variability at the 0.5 m than the 1.0 m scale. Detection of invasive species (CIAR, CIVU, IVAX) was consistently less using the line-point method than with Grant's. Overall, species detection within the three plots varied greatly even within one method, and there were no consistent trends among the three methods.

In the greasewood alliance, each method detected bare ground, however, the amount detected varied among methods (figure 3). Additionally, bare ground was quite different among the three plots when using the same method, suggesting that the characteristics of each plot differ and that plot differences are recorded by these methods. The three methods were not consistent in the amount of variability included in recording bare ground. Grant 1.0 m scale consistently detected more greasewood, with less variability than the line-point intercept method. The ability to detect the invasive cheatgrass (*Bromus tectorum. BRTE*) differed among the methods. In two of the plots, cheatgrass data were more variable using Grant's method than the line-point intercept. In the third plot however, Grant's detected cheatgrass on only one of three transects.

DISCUSSION and CONCLUSION

Differences in species and bare ground detection may be attributed to the fundamental differences inherent in each method. Grant's method may not be as time-efficient as the line-point intercept in shrub systems because it requires a lot of time *apriori* to identify alliances presently on the landscape; much of the labor and time is completed before actually getting to the field. Additionally, Grant's method uses an ocular estimation of species within quadrats, whereas the line-point intercept uses interception at and below the canopy level to detect species and ground cover. Bare ground was detected best in smooth brome vegetation using the line-point intercept because the line point method forces observation of soil surface. This same issue was not evident in the greasewood where bare ground was more visible. The precision of the line-point intercept appears to focus observations and reduce variability within datasets. Ocular estimation of Grant's method is easy to use, but much more subjective. Grant's method, using the smaller quadrat (0.5 m) seems to have introduced excessive variation in the data when shrubs are present.

To take full advantage of the different strengths and minimize observed limitations, the two methods could best be used in combination in a long-term monitoring program. The addition of Grant's method may increase observation of species with minimal cover that are not readily detected by line-point intercept (in other words indicator or threatened species; Herrick and others 2005b). However, used alone, Grant's method may not accurately depict the coverage of bare ground and may introduce variation that makes it difficult to discern management trend. For this reason, if the focus of the study is species presence and floristics, Grant's may be preferred over line-point intercept. However, because site characteristics such as bare ground are critical to ecosystem function, and because managers must document response to management actions over time (trend), use of only the Grant method may not be effective.

Given the ease of use of Grant's method, it could be incorporated with almost any other monitoring program. Because Brown's Park National Wildlife Refuge requires a rigorous baseline vegetation monitoring program, Grant's method could be incorporated into other monitoring methods as a frequent repeat monitoring technique, once more detailed baseline inventories are complete. We suggest using Grant's method for repeat interim monitoring, coupled with more detailed, less frequent monitoring methods such as line-point intercept and belt transects.

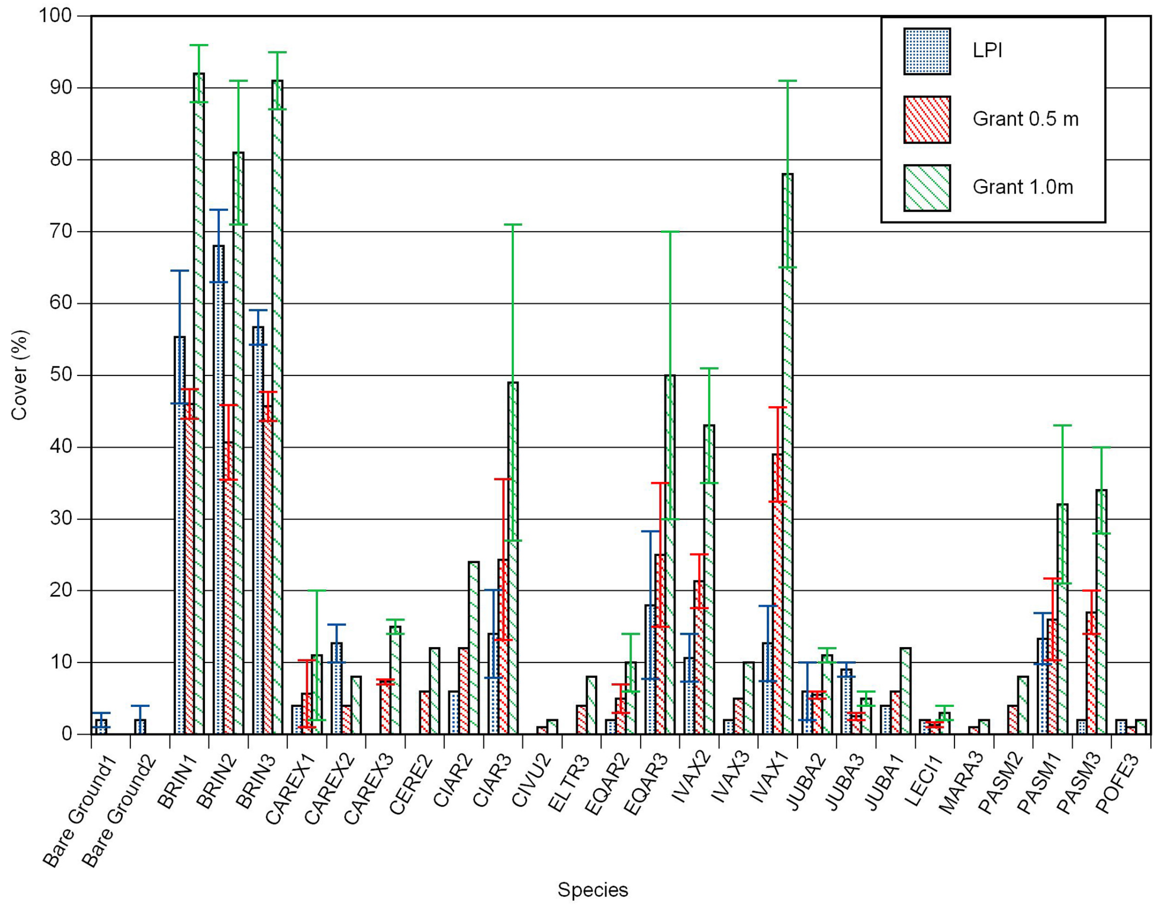

Figure 2—Cover attributes of three smooth brome plots recorded using three monitoring methods (line-point intercept (LPI), Grant 0.5 m resolution and Grant 1.0 m resolution). Error bars are one standard error of the mean per plot (3 line transects.) Species columns without error bars were recorded on only one of three transects within a plot. Species lack columns for a given method when the species was not detected by the method. Species name abbreviations are detailed in table 1.

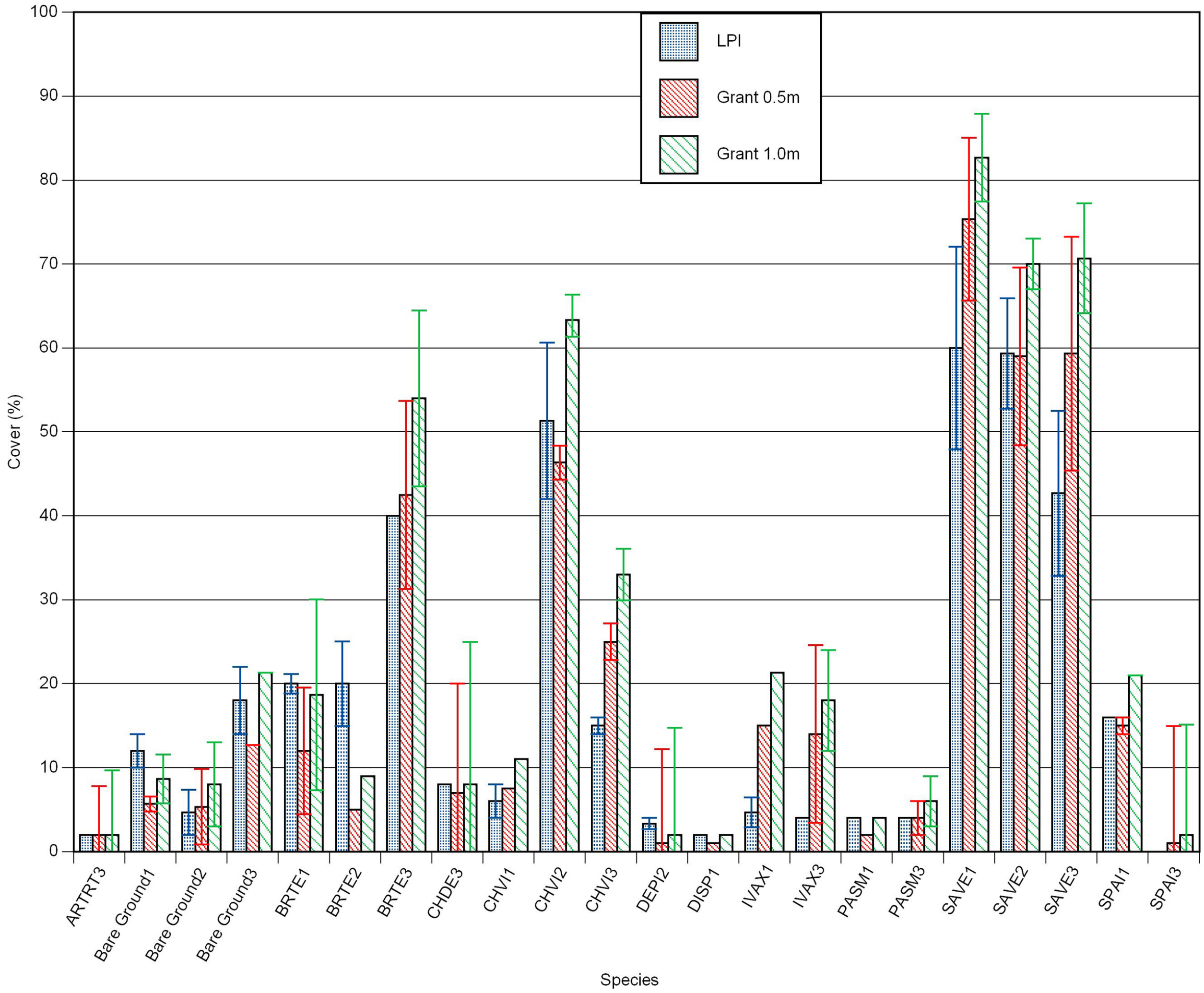

Figure 3—Cover attributes of three greasewood plots recorded using three monitoring methods (line-point intercept (LPI), Grant 0.5 m resolution and Grant 1.0 m resolution). Error bars are one standard error of the mean per plot (3 line transects). Species columns without error bars were recorded on only one of three transects within a plot. Species lack columns for a given method when the species was not detected by the method. Species name abbreviations are detailed in table 1.

REFERENCES

Barker, P. 2001. A technical manual for vegetation monitoring. Resource Management and Conservation, Department of Primary Industries, Water and Environment. Hobart, Tasmania. 79 p.

Canfield, R.H. 1941. Application of the line intercept method in sampling range vegetation. Journal of Forestry. 39:388-394.

Elzinga, C.L., Salzier, D.W., Willoughby, J.W. 1998. Measuring & monitoring plant populations. BLM Technical Reference 1730-1. 477 p.

Grant, T.A., Madden E.M., Murphy, R.K., Smith, K.A., Nenneman, M.P. 2004. Monitoring native prairie vegetation: the belt transect method. Ecological Restoration. 22:106-112.

Herrick, J.E., Van Zee, J.W., Havstad, K.M., Burkett, L.M., Whitford, W.G. 2005b. Montitoring manual for grassland, shrubland, and savanna ecosystems. Volume II: Design, supplementary methods and interpretation. USDA-ARS Jornada Experimental Range, Las Cruces, NM. 200 p. http://usda-ars.nmsu.edu/monit_assess/monitoring.php

U.S. Fish and Wildlife Service. 1999. Brown's park national wildlife refuge comprehensive conservation plan. 83 p.