



Integrated Upland Vegetation and Soils Monitoring for Glen Canyon National Recreation Area

2008 Summary Report

Natural Resource Data Series NPS/SCPN/NRDS—2009/017



ON THE COVER
Desert Sand ecological site
Photograph by: Jim DeCoster

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James K. DeCoster
Megan C. Swan

National Park Service
Southern Colorado Plateau Network
Northern Arizona University
P.O. Box 5765
Flagstaff, AZ 86011-5765

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The corresponding author and project manager for this project is Jim DeCoster (jim_decoster@nps.gov). Megan Swan is the botanist and crew leader for the project. Other contributions were made by the SCPN staff. The 2008 field crew consisted of Jessica Erickson, Anna Lowell, and Eric Vasquez.

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Introduction and Background

The National Park Service Inventory and Monitoring (I&M) Program was designed to determine the current status and monitor long-term trends in the condition of park natural resources, providing park managers with a strong scientific foundation for making decisions and working with other agencies and the public for the protection of park ecosystems. The Southern Colorado Plateau Network (SCPN) is monitoring vegetation and soils as overall indicators of upland ecosystem integrity (Thomas et al. 2006).

At Glen Canyon National Recreation Area (GLCA), SCPN and park staff selected the Desert Sand ecological site to monitor for vegetation and soils. An ecological site is a landscape division with characteristic soils, hydrology, plant communities, and disturbance regimes and responses. The classification of ecological sites is based on soil survey data (Butler et al. 2003). The Desert Sand ecological site encompasses large portions of the park unit, and the ecosystem faces a number of threats, including climate change, livestock grazing impacts, soil erosion, and invasion by nonnative species.

In 2008 the Integrated Upland Monitoring program of SCPN began upland monitoring at GLCA. In this report, we document monitoring activities in the 2008 field season and summarize the data that were collected.

Methods

Sampling frame

A sampling frame is the area from which sites are randomly selected, and hence the area to which statistical inferences can be made. We typically derive our sampling frames from maps of ecological sites developed by the US Natural Resources Conservation Service (See Appendix A of DeCoster et al., in review). However, defining the sampling frame was challenging because the soils map was outdated and the area is currently being remapped. In order to begin sampling prior to the completion of the new soil map, we selected an initial sampling frame that encompassed all potential Desert Sand sites in the park unit. We then developed a smaller, secondary sampling frame located in an area that had already been mapped as Desert Sand ecological site in the 2008 NRCS mapping effort. Once the new soil map is finalized, we will use it to create the final Desert Sand sampling frame.

We modified the initial sampling frame using Geographic Information System (GIS) technology by removing roads and areas with slopes exceeding 20% (fig. 1). A large set of spatially distributed sampling points was generated using the Generalized Random-Tessellation Stratified (GRTS) design (Stevens and Olsen 2004) across the entire park unit. We submitted the points that landed within the secondary sampling frame to park staff to give them the opportunity to reject sites that landed on archaeological sites or other sensitive resources. Before establishing a plot, the Integrated Upland crew conducted an ecological site assessment for each sampling point, and they rejected the site if it (1) did not fall within the ecological site, (2) had a slope exceeding 20%, or (3) contained a major disturbance.

Field methods

The SCPN Upland Monitoring crew began monitoring at GLCA in 2008 with the establishment of 10 plots in the Desert Sand ecological site. They installed and collected data on all the plots in May.

Field methodology is described in detail in the SCPN Integrated Upland Protocol (DeCoster et al. in review). Plots are 0.50 ha in size, measuring 71 m x 71 m. All vegetation data and soil data were col-

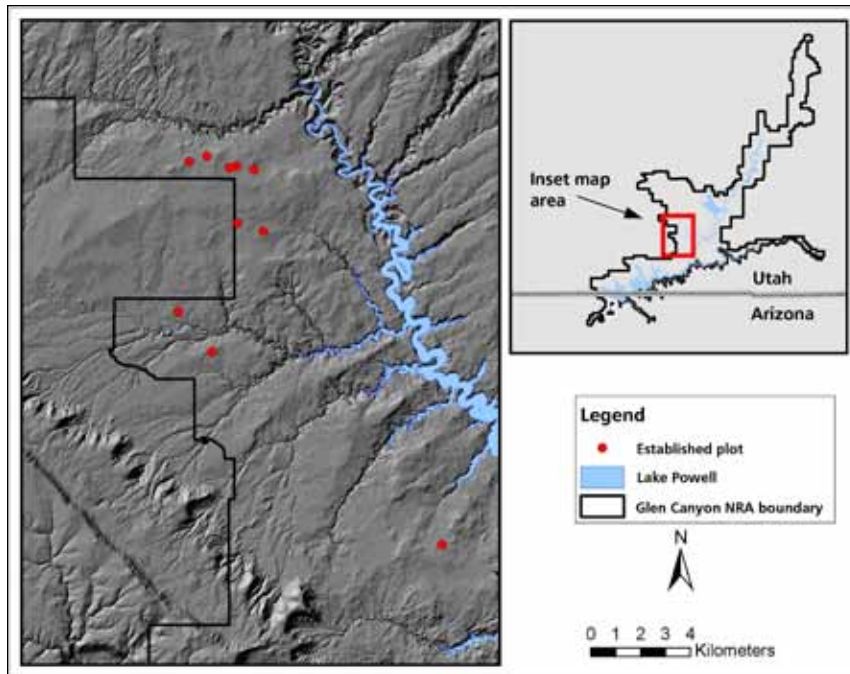


Figure 1. Sampling frame of Desert Sand ecological site with the 10 plots established in 2008.

lected on three 50 m transects, spaced 25 meters apart, within each plot.

Shrub and herbaceous vegetation

At 10 m intervals along each transect, the crew sampled shrub and herbaceous vegetation with five sets of nested quadrats. The largest quadrat size was 10 m² (2m x 5m), with four smaller quadrats nested inside (0.01 m², 0.1 m², 1 m², 5 m²). The presence of individual vascular species was recorded for each nested sub-quadrat. Percent cover of each herbaceous and shrub species was then estimated in the 10 m² quadrat and recorded as one of 12 cover classes, e.g. 2-5%, 5-10%, etc. Percent cover for functional groups (e.g. graminoids, forbs, shrubs) was also estimated in the largest quadrat and recorded as one of 12 cover classes.

Overstory trees and saplings

There were no trees in any of the plots.

Soil stability and hydrologic function

The crew measured the amount of bare soil by recording the length of each basal gap (the space between plant bases) along each transect. A soil aggregate stability test was conducted, using 18 soil samples collected along the transects. Percent cover of ground surface features was estimated in the 1 m² quadrats in conjunction with the shrub and herbaceous data and recorded as one of 12 cover classes.

Data summary

The sample unit for summary and analysis is the plot; hence, we summarized all data at the level of the plot. In order to calculate summary statistics for the ecological site, means and standard deviations were calculated from the plot means.

For herbaceous and shrub vegetation, cover and frequency were calculated for each species from

the cover class midpoints, e.g. using 7.5% for cover class 5-10%. The mean cover was calculated for each plot, and the mean, standard deviation (SD), and range of cover (range between the minimum and maximum of measured foliar covers, only including those plots where the species occurs) were calculated for the ecological site. Species frequency was calculated for quadrats (mean percentage of quadrats per plot where the species occurs) and for plots (percentage of plots where the species occurs). Mean cover and SD of functional groups and surface features were calculated in a similar fashion.

We calculated four diversity measures for herbaceous and shrub species (Magurran 1988)—first for all species in a site and then for native species only.

(1) Species richness (S) is the number of species at a given spatial scale, and it was calculated at all spatial scales (i.e. for each nested quadrat size, for the plot, and for the ecological site).

(2) The Shannon Diversity Index (H') provides a measure of species diversity that takes into account the relative abundance of each species:

$$- \sum_{i=1}^n p_i \ln p_i$$

where p_i is the abundance of each species.

(3) Species evenness (J') is a measure of the degree to which all species are equal in abundance:

$$H' / \ln(S)$$

(4) Beta diversity (β_w) is a measure of within-ecological site heterogeneity (diversity among plots):

$$S_e / (S_p - 1)$$

where S_e is the total number of species found in the ecological site, and S_p is the mean number of species found per plot.

We made five calculations for the basal gaps data: (1) median basal gap size, (2) percentage of transects comprised by gaps, (3) percentage of transects comprised by gaps ≥ 50 cm, (4) number of gaps by size class, and (5) total number of gaps. Mean and SD were calculated for each metric.

The mean soil aggregate stability index was calculated along with the standard deviation. This index ranges between 1 and 6, where 1 indicates low aggregate stability and 6 indicates high aggregate stability. The index was also calculated separately for samples with vegetative cover and for samples without vegetative cover.

Results

Shrub and herbaceous vegetation

Shrubs dominated the vegetation of the GLCA Desert Sand ecological site (table 1). Of the ten most abundant species, seven were shrubs, including *Psoralea fremontii* (Fremont's dalea), *Artemisia filifolia* (sand sage), *Coleogyne ramosissima* (blackbrush), *Gutierrezia sarothrae* (broom snakeweed), *Eriogonum leptocladon* (sand buckwheat), and *Chrysothamnus Greenei* (Greene's rabbitbrush). Common forbs included *Plantago patagonica* (wooly plantain), *Astragalus lentiginosus*

(freckled milkvetch), and *Oenothera pallida* (pale evening primrose). Common grasses included perennial *Sporobolus* spp. (a grouping of dropseed species that includes *S. airoides*, *S. contractus*, and *S. cryptandrus* individuals that were not determinable to species at time of sampling) and the annual *Vulpia octoflora* (sixweeks fescue). The succulent *Opuntia* spp. (prickly pear) was common in the plots. Species composition was moderately variable among plots; many species had wide ranges and standard deviations that approximated their means. A number of species were patchily distributed, as is evidenced by low quadrat and plot frequencies. *Bromus tectorum* (cheatgrass) was the only non-native species found in the plots. It occurred in 80% of the plots, but with low cover. Appendix A lists all the species found, along with common names, families, mean foliar cover, and plot frequency.

The cover of functional groups confirms the dominance of shrubs (table 2). Cover of live vegetation was 11.58%, and shrub cover was 8.20%. Forbs had a mean cover of 2.23%. Perennial grass, annual grass, and cacti/succulents each comprised less than 1% cover. Standard deviations and ranges were generally less the standard deviations and ranges of the individual species. Cover of standing dead herbaceous was low, 0.38%, while standing dead woody cover was 2.10%

A total of 55 species was recorded in this ecological site, with a mean species richness of 25.8 species per plot (table 3). Shannon diversity was 2.233, which is moderate. Values generally fall between 1.5 and 3.5 (Margalef 1972). Evenness was moderately high—0.688. The Evenness Index is bounded by 0 and 1, where a value of 1 indicates that all species are of equal abundance. Beta diversity was 2.218, which is moderate. High values (greater than 5) indicate large differences among plots, whereas low

Table 1. Foliar cover and frequency of the fifteen most abundant shrub and herbaceous species and all nonnative species.

Species	Foliar cover (%)			Frequency (%)	
	Mean	SD	Range	Quadrat	Plot
<i>Psoralea argophylla</i>	1.156	0.833	0.150 - 3.000	36.00	100
<i>Plantago patagonica</i>	0.873	0.737	0.010 - 2.670	86.67	100
<i>Artemisia filifolia</i>	0.871	0.584	0.300 - 2.210	50.67	100
<i>Coleogyne ramosissima</i>	0.776	1.046	0.050 - 2.900	16.00	80
<i>Gutierrezia sarothrae</i>	0.702	1.051	0.020 - 3.007	33.33	70
<i>Astragalus lentiginosus</i>	0.621	0.626	0.020 - 2.037	30.00	80
<i>Eriogonum leptocladon</i>	0.618	0.464	0.073 - 1.207	39.33	80
<i>Chrysothamnus Greenei</i>	0.474	1.036	1.787 - 2.953	12.67	20
<i>Sporobolus</i> spp.	0.319	0.385	0.103 - 1.070	54.00	60
<i>Vandeweyea stylosa</i>	0.311	0.349	0.433 - 0.900	14.67	50
<i>Opuntia</i> spp.	0.194	0.202	0.003 - 0.607	21.33	100
<i>Oenothera pallida</i>	0.177	0.303	0.413 - 0.837	21.33	30
<i>Sporobolus cryptandrus</i>	0.114	0.145	0.070 - 0.333	32.67	50
<i>Abronia fragrans</i>	0.101	0.305	0.040 - 0.967	10.67	20
<i>Vulpia octoflora</i>	0.095	0.088	0.023 - 0.307	66.67	90
<i>Bromus tectorum</i> ^a	0.023	0.033	0.003 - 0.097	26.67	80

Note: The ranges only include plots where the species occurs. (Many species do not occur in every plot of an ecological site; for these species, we did not include the plots with 0% cover in the range).

^aNonnative species.

Table 2. Foliar cover of functional groups at Glen Canyon National Recreation Area.

Functional group	Foliar cover (%)		
	Mean	SD	Range
Total live vegetation	11.58	2.68	7.27 - 14.00
Perennial grass	0.52	0.29	0.19 - 1.14
Annual grass	0.11	0.10	0.00 - 0.37
Forbs	2.23	1.30	0.86 - 5.13
Shrubs, dwarf shrubs	8.20	2.42	5.12 - 11.07
Cacti, succulents	0.19	0.16	0.02 - 0.42
Standing dead herbaceous	0.38	0.13	0.26 - 0.64
Standing dead woody	2.10	0.75	1.28 - 3.83

Note: Components of total live vegetation are not strictly additive because calculations were made from cover class midpoints, the various components may have overlapped, and estimations were made independently.

Table 3. Species diversity metrics for all species and for native species only.

Metric	Mean	SD	Range
All species			
Plot			
Plot richness	25.8	4.3	21 – 34
Shannon diversity	2.233	0.223	
Evenness	0.688	0.042	
Ecological site			
Ecological site richness	55		
Beta diversity	2.218		
Native species			
Plot			
Plot richness	25.2	4.2	21 – 34
Shannon diversity	2.225	0.224	
Evenness	0.691	0.043	
Ecological site			
Ecological site richness	54		
Beta diversity	2.231		

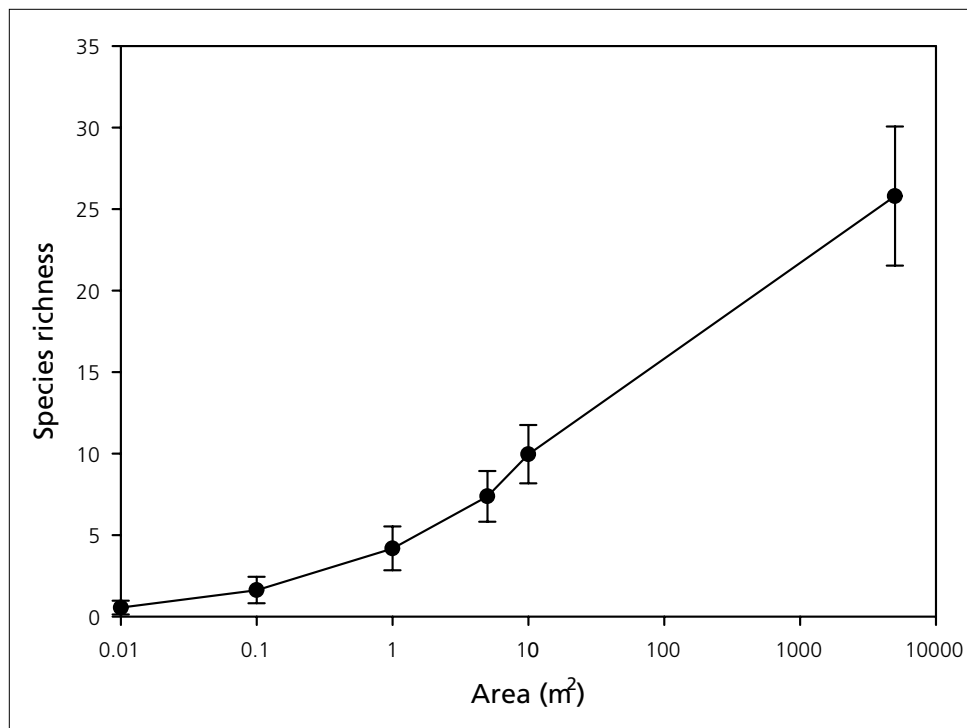


Figure 2. Species-area curve, showing species richness at six spatial scales. Estimates are based on 10 plots with 15 quadrats each. The point at 5000 m² represents plot species richness. Error bars represent one standard deviation.

values (less than 1) indicate similar composition (McCune and Grace 2002). When these indices were recalculated using only native species, they changed by only small amounts (table 3). The species area curve (fig. 2) illustrates how species richness accumulates with increased area. The shape of the curve for this ecological site is unusual. The lower half is concave, which is fairly typical for shrublands in the region. However, plot richness is lower than would be expected—the slope from 10m² to 5000 m² is less than the slope from 5 m² to 10 m². This suggests relatively low species richness at the plot scale and relatively high richness at the 10 m² (quadrat) scale.

Soil stability and hydrologic function

The crew monitored the amount of exposed soil in two ways: estimates of ground surface feature cover in quadrats and basal gap intercepts. The cover of ground surface features (table 4) shows that the dominant features were bare soil (41.73%), undifferentiated (physical) crust (39.88%), and duff and litter (7.48%). Cover of live plant base and cyanobacteria each comprised between 1 and 5%. The cover of the three smaller rock components, dead herbaceous base, dead woody base, moss, and woody debris were each less than 1%. There was no stone/bedrock or lichen in any of the plots. Variability of the surface features among plots was generally moderate, although bare soil and undifferentiated crust had large ranges.

The basal gap data (table 5) indicate that 99.0% of total transect length is gap; consequently only 1.0% intersects plant bases. (Note that this figure is much lower than the cover of plant base in the surface feature data). When only gaps greater than 50 cm were considered in the percentage of transect in gaps, the figure only dropped a small amount, from 99.0% to 97.8%. The predominance of large gaps is further suggested by the median gap size of 207.9 cm and the size distribution of gaps (fig. 3). These large gaps are the areas most susceptible to erosion.

Soil aggregate stability provides a measurement of the erodibility of the soil (table 6). The mean rating was 1.91, indicating low stability. Soil occurring under vegetative cover had a higher aggregate stability rating than bare soil without cover: 2.94 compared to 1.59.

Table 4. Cover of ground surface features at Glen Canyon National Recreation Area.

Surface feature	Cover (%)		
	Mean	SD	Range
Live plant base	2.91	0.77	1.89 - 3.91
Dead woody base	0.48	0.27	0.16 - 1.09
Dead herbaceous base	0.75	0.25	0.37 - 1.09
Bare soil	41.73	30.57	2.61 - 79.83
Duff and litter	7.48	4.52	1.72 - 15.57
Undifferentiated crust	39.88	29.53	0.83 - 74.33
Moss	0.38	0.49	0.00 - 1.57
Lichen	0.00	0.00	0.00 - 0.00
Cyanobacteria	3.13	2.31	0.15 - 6.07
Fine gravel (0.2 cm- 2cm)	0.09	0.11	0.00 - 0.31
Coarse gravel (2cm – 7.5 cm)	0.05	0.09	0.00 - 0.27
Cobble (7.5 cm – 25 cm)	0.01	0.02	0.00 - 0.05
Stone, bedrock (>25 cm)	0.00	0.00	0.00 - 0.00
Woody debris	0.44	0.35	0.02 - 1.11

Note: The features do not add up to 100% because the calculations are made from cover class midpoints, and the estimations have observer error.

Table 5. Number of basal gaps, mean gap size and percentage of total transect length comprised by gaps.

Metric	Mean	(SD)
Gap number	42.3	(9.5)
Median gap size (cm)	207.9	(81.3)
Percent of transect in gaps	99.0	(0.2)
Percent of transect in gaps $\geq$ 50 cm	97.8	(0.8)

Table 6. Soil stability rating for samples with and without vegetative cover.

Metric	Mean	(SD)
With vegetative cover	2.94	(1.16)
Without vegetative cover	1.59	(0.36)
All samples	1.91	(0.36)

Note: A rating of 1 is the lowest stability, and a rating of 6 is the highest stability.

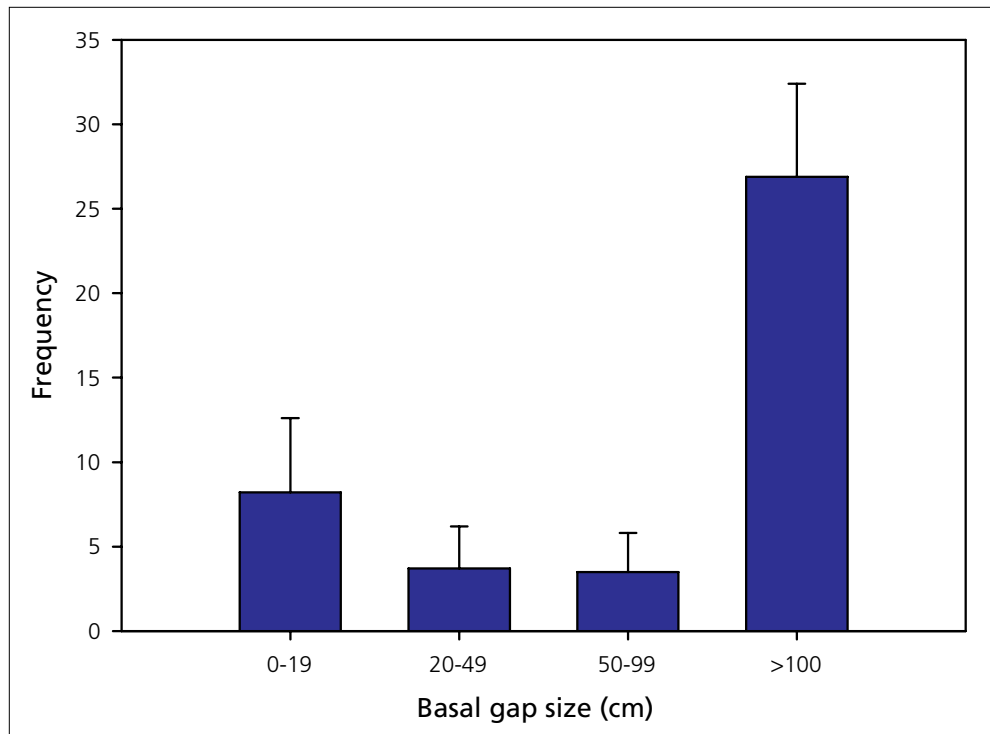


Figure 3. Frequency distribution of the basal gaps sizes. Error bars indicate one standard deviation.

Discussion

These data represent the first year baseline of sampling for the Desert Sand ecological site of GLCA. The site was dominated by a diverse mixture of shrubs, specifically *Psoralea fremontii*, *Artemisia filifolia*, *Coleogyne ramosissima*, *Gutierrezia sarothrae*, *Eriogonum leptocladon* and *Chrysothamnus greenii*. Grasses and forbs were less abundant. Common forbs included *Plantago patagonica*, *Astragalus lentiginosus*, and *Oenothera pallida*. Common grasses included *Sporobolus* spp. and *Vulpia octoflora*. The data indicate a shrubland of moderate diversity. *Bromus tectorum* was the only nonnative species found in the plots. While it occurred in every plot, it did not have high foliar cover.

Soil aggregate stability and the amount of exposed soil are measurements that quantify the potential of the site for soil erosion. Low soil aggregate stability, which we found at this site, is expected for sandy soils. The potential for erosion at the Desert Sand ecological site is high because of its extensive areas occupied by large basal gaps, the low amount of biological crusts, and the low soil aggregate stability.

The SCPN Integrated Upland crew plans to sample the quadrats and gap intercept transects annually for 3-5 years to determine the range of variability for key metrics. Power analysis will then be used to determine the total number of plots necessary to detect change in the key metrics. When the current soil survey is complete, we will expand the sampling frame to include the entire of the Desert Sand ecological site that meets our sampling criteria within the park. A temporal sampling design will then be implemented, with the installation of additional plots in subsequent years. Each year's data will be compared with the previously collected data to analyze changes through time in vegetation composition and structure and in soil stability and hydrologic function. More thorough trend analyses will be conducted once sufficient data have been collected.

Literature Cited

- Butler, L. D., J. B. Cooper, R. H. Johnson, A. J. Norman, G. L. Peacock, P. L. Shaver and K. E. Spaeth. 2003. National range and pasture handbook. USDA, NRCS, Grazing Lands Technology Institute, Fort Worth, TX.
- DeCoster, J. K., C. L. Lauver, M. E. Miller, J. R. Norris, A. E. C. Snyder, M. C. Swan, L. P. Thomas and D.L. Witwicki. Integrated upland monitoring protocol for the Southern Colorado Plateau Network. Natural Resource Technical Report, National Park Service, Fort Collins, CO, in review.
- Magurran, A. E. 1988. Ecological diversity and its measurement. Princeton University Press, Princeton, NJ.
- Margalef, R. 1972. Homage to Evelyn Hutchinson, or why there is an upper limit to diversity. Transactions of the Connecticut Academy of Arts and Sciences 44: 211-35.
- McCune, B. and J. B. Grace. 2002. Analysis of ecological communities. MJM Software Design.
- Stevens, D. L. and A. R. Olsen. 2004. Spatially balanced sampling of natural resources. Journal of the American Statistical Association 99: 262-278.
- Thomas, L. P., M. N. Hendrie (editor), C. L. Lauver, S. A. Monroe, N. J. Tancreto, S. L. Garman, and M. E. Miller. 2006. Vital signs monitoring plan for the Southern Colorado Plateau Network. Natural Resource Report NPS/SCPN/NRR-2006/002. National Park Service, Fort Collins, CO.

Appendix A

Complete species list with foliar cover and frequency values for herbaceous and shrub species.

Species	Common name	Family	Foliar cover (%)	Plot frequency (%)
<i>Abronia fragrans</i>	snowball sand verbena	Nyctaginaceae	0.101	20
<i>Achnatherum hymenoides</i>	Indian ricegrass	Poaceae	0.055	80
<i>Amsonia tomentosa</i>	Amsonia tomentosa woolly bluestar	Apocynaceae	0.004	10
<i>Artemisia filifolia</i>	sand sagebrush	Asteraceae	0.871	100
<i>Asclepias asperula</i>	antelope horns	Asclepiadaceae	0.005	20
<i>Asclepias cryptoceras</i>	pallid milkweed	Asclepiadaceae	<0.001	10
<i>Astragalus amphioxys</i>	Crescent milkvetch	Fabaceae	<0.001	10
<i>Astragalus lentiginosus</i>	specklepod milkvetch	Fabaceae	0.621	80
<i>Bromus tectorum</i> ^a	cheatgrass	Poaceae	0.023	60
<i>Chaenactis stevioides</i>	Steve's dustymaiden	Asteraceae	0.062	60
<i>Chamaesyce parryi</i>	Parry's sandmat	Euphorbiaceae	0.018	40
<i>Chrysothamnus Greenei</i>	Greene's rabbitbrush	Asteraceae	0.474	20
<i>Coleogyne ramosissima</i>	blackbrush	Rosaceae	0.776	80
<i>Comandra umbellata</i>	bastard toadflax	Santalaceae	0.066	40
<i>Cordylanthus wrightii</i>	Wright's bird's beak	Scrophulariaceae	0.014	20
<i>Cryptantha</i> spp.	cryptantha	Boraginaceae	0.046	100
<i>Cryptantha flava</i>	Brenda's yellow cryptantha	Boraginaceae	0.002	10
<i>Descurainia pinnata</i>	western tansymustard	Brassicaceae	0.001	20
<i>Dimorphocarpa wislizeni</i>	spectacle pod	Brassicaceae	0.008	20
<i>Ephedra viridis</i>	Mormon tea	Ephedraceae	2.794	100
<i>Erigeron bellidiastrum</i>	western daisy fleabane	Asteraceae	0.029	70
<i>Eriogonum leptocladon</i>	sand buckwheat	Polygonaceae	0.618	80
<i>Gutierrezia sarothrae</i>	broom snakeweed	Asteraceae	0.702	70
<i>Helianthus annuus</i>	common sunflower	Asteraceae	0.000	10
<i>Hymenopappus filifolius</i>	fineleaf hymenopappus	Asteraceae	0.042	60
<i>Ipomopsis gunnisonii</i>	sanddune ipomopsis	Polemoniaceae	0.050	100
<i>Lepidium montanum</i>	mountain pepperweed	Brassicaceae	0.040	10
<i>Linum aristatum</i>	bristle flax	Linaceae	0.008	60
<i>Lupinus pusillus</i>	rusty lupine	Fabaceae	0.019	70
<i>Machaeranthera</i> sp.	tansy aster	Asteraceae	<0.001	10
<i>Mentzelia albicaulis</i>	whitestem blazingstar	Loasaceae	<0.001	10
<i>Mentzelia multiflora</i>	Adonis blazingstar	Loasaceae	0.010	30
<i>Monroa squarrosa</i>	false buffalograss	Poaceae	0.001	20
<i>Muhlenbergia pungens</i>	sandhill muhly	Poaceae	0.007	30
<i>Oenothera pallida</i>	pale evening-primrose	Onagraceae	0.177	30
<i>Opuntia</i> spp.	prickly pear	Cactaceae	0.194	100

Appendix A, continued.

<i>Penstemon ambiguus</i>	pink plains beardtongue	Scrophulariaceae	0.053	20
<i>Phacelia ivesiana</i>	Ives' phacelia	Hydrophyllaceae	0.004	10
<i>Plantago patagonica</i>	woolly plantain	Plantaginaceae	0.873	100
<i>Pleuraphis jamesii</i>	James' galleta	Poaceae	0.044	20
<i>Poliomintha incana</i>	frosted mint	Lamiaceae	0.054	30
<i>Psoralea fremontii</i>	Fremont's dalea	Fabaceae	1.156	100
<i>Sphaeralcea grossulariifolia</i>	gooseberryleaf globemallow	Malvaceae	0.037	90
<i>Sporobolus</i> spp.	dropseed	Poaceae	0.319	60
<i>Sporobolus contractus</i>	spike dropseed	Poaceae	0.001	20
<i>Sporobolus cryptandrus</i>	sand dropseed	Poaceae	0.114	50
<i>Sporobolus flexuosus</i>	mesa dropseed	Poaceae	0.018	20
<i>Stephanomeria exigua</i>	small wirelettuce	Asteraceae	0.055	100
<i>Townsendia incana</i>	hoary Townsend daisy	Asteraceae	0.000	10
<i>Vanclevea stylosa</i>	pillar false gumweed	Asteraceae	0.311	50
<i>Vulpia octoflora</i>	sixweeks fescue	Poaceae	0.095	90
<i>Yucca angustissima</i>	narrowleaf yucca	Agavaceae	0.037	80
<i>Zigadenus paniculatus</i>	foothill deathcamas	Liliaceae	0.028	50
Unknown 2008May13-4			0.020	10
Unknown 2008May21-2			<0.001	10

^a Nonnative species