



Terrestrial Vegetation and Soils Monitoring in the Tucson Mountain District, Saguaro National Park, 2009–2010

Natural Resource Data Series NPS/SODN/NRDS—2011/183



ON THE COVER

Sunset at Saguaro National Park–Tucson Mountain District. NPS photo.

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The Natural Resource Data Series is intended for timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data.

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Contents

- Figuresv
- Tablesv
- Executive Summaryvii
- Acronymsix
- Acknowledgementsxi

- 1 Introduction1
 - 1.1 Background1
 - 1.2 Goals and objectives1
 - 1.3 Scope of this report1

- 2 Methods.....3
 - 2.1 Response design.....3
 - 2.2 Sampling design3

- 3 Results.....11
 - 3.1 Vegetation monitoring results.....11
 - 3.2 Evaluation of strata11
 - 3.3 Estimates of power and species detectability11

- 4 Discussion15
 - 4.1 Are the strata effective?.....15
 - 4.2 Does the sample size meet our criteria?.....15
 - 4.3 Implications for terrestrial vegetation and soils monitoring16

- 5 Literature Cited17

- Appendix A. Supplementary Data Tables.....19

Figures

| | |
|--|----|
| Figure 1-1. Tucson Mountain District, Saguaro National Park | 2 |
| Figure 2-1. Terrestrial vegetation and soils monitoring plot design. | 4 |
| Figure 2-2. Distribution of terrestrial vegetation and soils monitoring plots at the Tucson Mountain District, Saguaro NP, 2009–2010 | 5 |
| Figure 2-3. Modeled travel time relative to terrestrial vegetation and soil plot locations, Tucson Mountain District, Saguaro NP | 7 |
| Figure 3-1. Non-metric multidimensional scaling indicates similarity of (a) field, (b) subcanopy, and (c) canopy layer communities | 12 |
| Figure 3-2. Species area curves for cover and frequency data collected on terrestrial vegetation and soils plots at Saguaro NP–Tucson Mountain District in 2009 and 2010 | 13 |

Tables

Main Report

| | |
|---|----|
| Table 2-1. Allocation of permanent terrestrial vegetation and soils monitoring plots by strata, Saguaro NP–Tucson Mountain District, 2009–2010 | 6 |
| Table 2-2. Sampling schedule for Saguaro NP–Tucson Mountain District | 8 |
| Table 3-1. Analysis of similarity (ANOSIM) pairwise-test results for contrasting vegetation composition by strata for (a) canopy, (b) subcanopy, and (c) field height classes for terrestrial vegetation monitoring, Saguaro NP–Tucson Mountain District, 2009–2010. | 11 |
| Table 4-1. Adjusted sampling schedule for Saguaro NP–Tucson Mountain District | 15 |

Appendix A

| | |
|---|----|
| Table A1a. Within-plot cover values (%) for species measured in the field layer of terrestrial vegetation and soils plots, 101 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 20 |
| Table A1b. Within-plot cover values (%) for species measured in the field layer of terrestrial vegetation and soils plots, 102 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 22 |
| Table A1c. Within-plot cover values (%) for species measured in the field layer of terrestrial vegetation and soils plots, 202 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 24 |
| Table A1d. Within-plot cover values (%) for species measured in the field layer of terrestrial vegetation and soils plots, 302 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 27 |
| Table A1e. Within-plot cover values (%) for species measured in the field layer of terrestrial vegetation and soils plots, all strata, Tucson Mountain District, Saguaro NP, 2009–2010..... | 29 |
| Table A2a. Within-plot cover values (%) for species measured in the subcanopy layer of terrestrial vegetation and soils plots, 101 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 31 |
| Table A2b. Within-plot cover values (%) for species measured in the subcanopy layer of terrestrial vegetation and soils plots, 102 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 33 |
| Table A2c. Within-plot cover values (%) for species measured in the subcanopy layer of terrestrial vegetation and soils plots, 202 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 35 |
| Table A2d. Within-plot cover values (%) for species measured in the subcanopy layer of terrestrial vegetation and soils plots, 302 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 37 |
| Table A2e. Within-plot cover values (%) for species measured in the subcanopy layer of terrestrial vegetation and soils plots, all strata, Tucson Mountain District, Saguaro NP, 2009–2010..... | 39 |
| Table A3a. Within-plot cover values (%) for species measured in the canopy layer of terrestrial vegetation and soils plots, 101 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 41 |

| | |
|--|----|
| Table A3b. Within-plot cover values (%) for species measured in the canopy layer of terrestrial vegetation and soils plots, 102 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 42 |
| Table A3c. Within-plot cover values (%) for species measured in the canopy layer of terrestrial vegetation and soils plots, 202 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 43 |
| Table A3d. Within-plot cover values (%) for species measured in the canopy layer of terrestrial vegetation and soils plots, 302 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 44 |
| Table A3e. Within-plot cover values (%) for species measured in the canopy layer of terrestrial vegetation and soils plots, all strata, Tucson Mountain District, Saguaro NP, 2009–2010. | 45 |
| Table A4a. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, 101 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 46 |
| Table A4b. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, 102 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 49 |
| Table A4c. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, 202 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 52 |
| Table A4d. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, 302 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 55 |
| Table A4e. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, all strata, Tucson Mountain District, Saguaro NP, 2009–2010. | 58 |
| Table A5a. Soil substrate (% by class) and surface aggregate stability class (mean and SE) and proportion of samples in "very stable" (=6) category, by monitoring plot, 101 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 61 |
| Table A5b. Soil substrate (% by class) and surface aggregate stability class (mean and SE) and proportion of samples in "very stable" (=6) category, by monitoring plot, 102 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 62 |
| Table A5c. Soil substrate (% by class) and surface aggregate stability class (mean and SE) and proportion of samples in "very stable" (=6) category, by monitoring plot, 202 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 63 |
| Table A5d. Soil substrate (% by class) and surface aggregate stability class (mean and SE) and proportion of samples in "very stable" (=6) category, by monitoring plot, 302 stratum, Tucson Mountain District, Saguaro NP, 2009–2010. | 64 |
| Table A5e. Soil substrate (% by class) and surface aggregate stability class (mean and SE) and proportion of samples in "very stable" (=6) category, by monitoring plot, all strata, Tucson Mountain District, Saguaro NP, 2009–2010. | 65 |

Executive Summary

This report summarizes data collected during the Sonoran Desert Network's first two seasons of terrestrial vegetation and soils monitoring in upland areas of the Tucson Mountain District, Saguaro National Park, in southern Arizona. Eleven permanent monitoring sites were sampled, with another 21 planned for 2011–2013, after which time a detailed status and trend report will be produced.

This report summarizes effort to date, evaluates the sampling design within the context of monitoring objectives, and suggests modifications to the design. Based on estimates from this initial data, the design did an excellent job of providing statistical power to detect trends in perennial species and soil stability. The design also provided good power for detecting changes in lifeform composition and soil surface cover, although our projected power for a few variables slightly exceeded our initial design criteria. Species detectability appeared to be very reasonable based on species-accumulation curves, although only about 17% of the known flora have been detected to date. (However, we are not differentiating annuals, with the exception of exotic plants, nor are we sampling aquatic, riparian, or xeroriparian systems as part of this protocol.)

The protocol's stratification scheme (elevation \times soil texture) is difficult to evaluate at this time. Vegetation community similarity of the four strata had few significant differences, with the exception of low-elevation fine-textured soils as compared to mid-elevation coarse soils. This lack of differentiation between strata is likely due to the small sample sizes of these more constrained areas of the park, although sampling efficiencies can be gained if the lack of differences is real. We will investigate this question by adding one site at high elevation in 2011, and by shifting the sampling schedule for the other small strata forward to 2011. Results will be analyzed in the 2011 data summary.

Overall, we conclude that the sampling and response designs are efficient and effective, and should provide data that meet our monitoring objectives. We will continue to evaluate and adjust our sampling strategy annually, culminating in the full analysis for a comprehensive status and trends report after the 2013 field season. Therefore, it is important that results in this and other annual data summaries not be directly interpreted for evaluating the condition of park resources.

Acronyms

| | |
|-------|---|
| AVG | average |
| GRTS | Generalized Random Tessellation Stratified |
| MDC | minimum detectable change |
| n | number |
| NP | national park |
| NPS | National Park Service |
| RRQRR | Reversed Randomized Quadrant Recursive Raster |
| SD | standard deviation |
| Sdiff | standard deviation of the differences |
| SE | standard error |
| SODN | Sonoran Desert Network |
| TMD | Tucson Mountain District |

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1 Introduction

1.1 Background

Generating more than 99.9% of Earth's biomass (Whittaker 1975), plants are the primary producers of life on our planet. Vegetation therefore represents much of the biological foundation of terrestrial ecosystems, and it comprises or interacts with all primary structural and functional components of these systems. Vegetation dynamics can indicate the integrity of ecological processes, productivity trends, and ecosystem interactions that can otherwise be difficult to monitor. Land-management actions often focus on manipulating vegetation to achieve park management objectives, with defined conditions based on community structure or lifeform composition.

In the Sonoran Desert and Apache Highlands ecoregions (Bailey 1998), vegetation composition, distribution, and production are highly influenced by edaphic factors, such as soil texture, mineralogy depth, and landform type (McAuliffe 1999). Especially as they relate to water, these influences are magnified at local scales, as described by pioneering desert ecologist Forrest Shreve:

The profound influence of soil upon desert vegetation is to be attributed to its strong control of the amount, availability and continuity of water supply. This fundamental requisite in plants is the most effective single factor in the differentiation of desert communities (Shreve 1951).

As such, a fundamental understanding of soils and landforms is essential for evaluating vegetation patterns and processes (McAuliffe 1999).

The Sonoran Desert Network (SODN), as part of the National Park Service's Inventory & Monitoring Program, has identified terrestrial vegetation and dynamic soil functional attributes as important ecosystem monitoring parameters, or "vital signs" (NPS 2005), that provide key insights into the integrity of terrestrial ecosystems at Saguaro National Park (NP; Figure 1-1). Indicators of terrestrial vegetation integrity include vegetation community structure, lifeform abundance, status and trends of established exotic plants, and early detection of previously undetected exotic plants. Indicators of soil dynamic function and erosion resistance include the cover of mineral soil, the

stability of surface soil aggregates, and the abundance of biological soil crusts.

1.2 Goals and objectives

The overall goal of the SODN terrestrial vegetation and soils monitoring program is to ascertain broad-scale changes in vegetation and dynamic soils properties in the context of changes in other ecological drivers, stressors, ecological processes, and focal resources of interest. This integrated approach explores patterns and identifies candidate explanations to support effective management and protection of park natural resources in a cumulative fashion, such that the results of each successive round of monitoring builds upon the knowledge gained from previous efforts and related research and monitoring activities.

Specific, measureable objectives for SODN terrestrial vegetation and soils monitoring (Hubbard et al. 2009) at Saguaro NP are to determine the status of and detect trends in (over five-year intervals):

1. Terrestrial *vegetation cover* for common ($\geq 10\%$ absolute canopy cover) perennial species, including non-native plants, and all plant lifeforms.
2. Terrestrial *vegetation frequency* of uncommon ($< 10\%$ absolute canopy cover) perennial species, including non-native plants.
3. Terrestrial *soil cover* by substrate classes (bare soil, litter, vegetation, biological soil crust, rock fragments of several size classes) that influence resistance to erosion.
4. Terrestrial *soil stability* of surface aggregates by stability class (1–6).
5. *Biological soil crust cover and frequency* by morphological group (lichen, moss, light cyanobacteria, dark cyanobacteria).

1.3 Scope of this report

This document summarizes the results of the first two years (2009 and 2010) of terrestrial vegetation and soils monitoring in the Tucson Mountain District of Saguaro NP. As Saguaro NP is the second largest unit in the Sonoran Desert Network, we employ a multi-year sampling strategy in which one-fifth of the monitoring sites are sampled in a given year, with the entire complement completed after five field seasons (= 2013).

Therefore, only 2/5 of one sampling cycle has occurred to date, and we do not synthesize and interpret the current information in the context of status or trends in this report. Instead, the objectives of this report are to:

1. Document the processed data from the first two years of this multi-year effort.
2. Evaluate the stratification approach and sample sizes based on vegetation similarity, estimated statistical power, and species detectability.
3. If warranted by the data, adjust strata and sample sizes to ensure we are meeting the monitoring objectives.

It is therefore critical that the reader not draw overall conclusions based on this report alone.

We will continue to produce annual data summaries and refine the sampling design as necessary, with a much more detailed and comprehensive synthesis report to be created after the final complement of sampling is completed in 2013. For an example of a status and trend synthesis report, see Terrestrial Vegetation and Soils Monitoring at Fort Bowie National Historic Site: 2008 Status Report (Hubbard et al. 2010), available at http://science.nature.nps.gov/im/units/sodn/digital_library.cfm.

We address the Rincon Mountain District of Saguaro NP elsewhere as a separate unit, reflecting the disconnected nature and substantial inherent ecological differences between the two units. Also, the thematic scope of this report is limited to terrestrial ecosystems; aquatic resources, including riparian and xeroriparian vegetation, are addressed in the SODN Streams and Washes protocols.

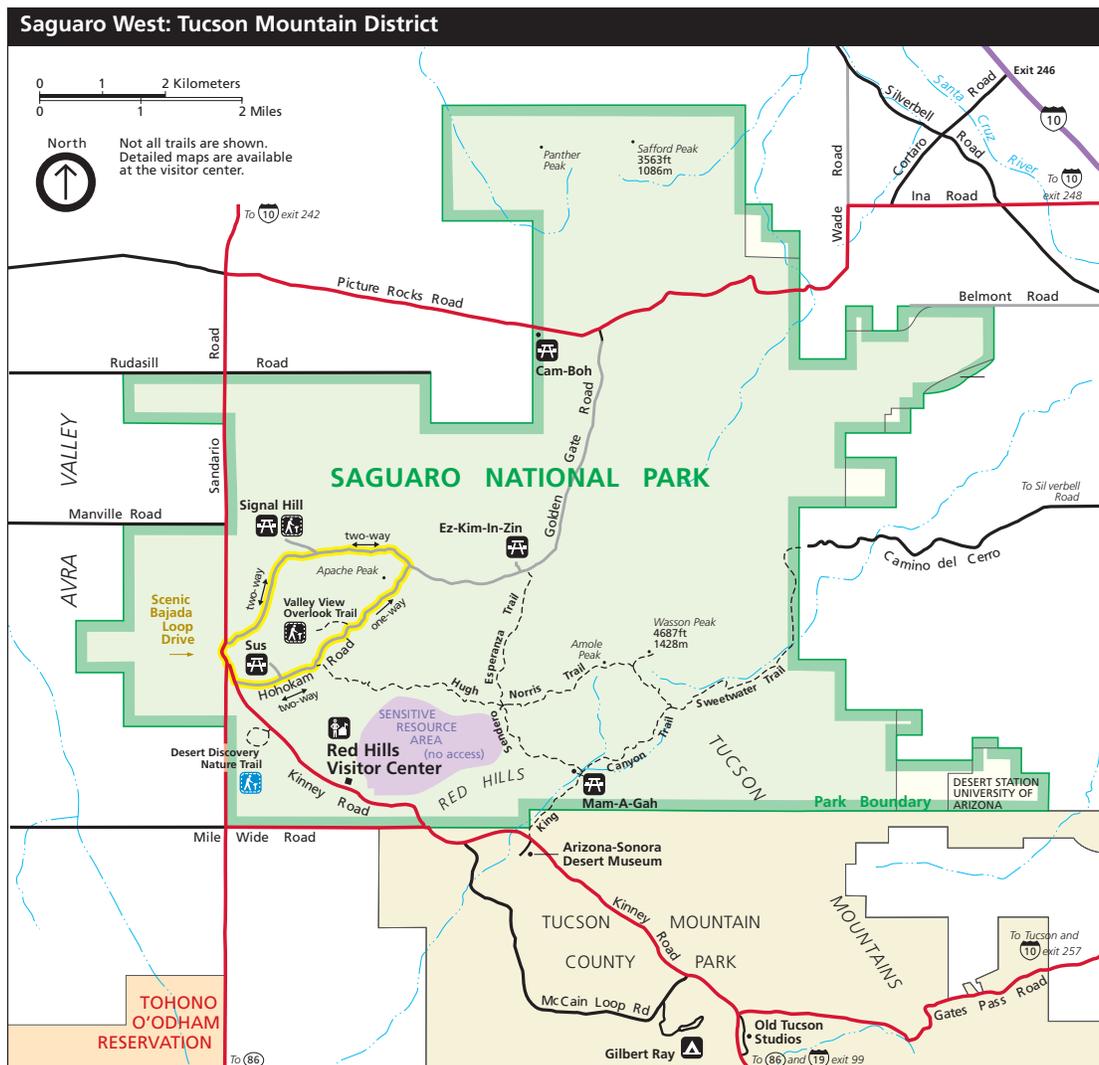


Figure 1-1. Tucson Mountain District, Saguaro National Park.

2 Methods

2.1 Response design

The response design for this protocol employs permanent, 20 × 50-m sampling plots (Figure 2-1). The 50-m edges of the plot run parallel with the contours of the site. Vegetation sampling is performed, in conjunction with soil cover and stability measures, along six transects within each plot. In the spaces between transects (subplots), within-plot frequency is estimated by noting the occurrence of any plant species or lifeform not observed on the adjacent transects. See Hubbard and others (in review) for details on plot configuration and data collection.

2.1.1 Vegetation, biological soil crust, and soil cover (line-point intercept)

Line-point intercept is a common and efficient technique for measuring the vegetation cover of plants. Line-point intercept measures the number of “hits” of a given species out of the total number of points measured (Elzinga et al. 1998; Bonham 1989). Vegetation was recorded within three height categories along each of the six transects using the line-point intercept method, with points spaced every 0.5 m (240 points total). The three height categories were field (<0.5 m), sub-canopy (0.5–2.0 m), and canopy (>2.0 m). Perennial vegetation was recorded to species and annual vegetation was recorded to lifeform, with the exception of a suite of annual non-native plants that were recorded to the species level. Soil cover (see Hubbard et al. in review, SOP #4) was recorded by substrate class (e.g., rock, gravel, litter), with biological soil crust cover (SOP #7) recorded to morphological group (e.g., light cyanobacteria, dark cyanobacteria, lichen, moss).

2.1.2 Vegetation frequency (subplots)

The area between any two adjacent transects formed the boundary of 10 × 20-m subplots that were used to estimate within-plot frequency of perennial plant species, exotic plants, and all lifeforms. The occurrence of any species/lifeform not measured on the adjacent line-point transect was recorded to determine a within-plot frequency of 0–5. Figure 2-1 explains the relationship between each subplot and its corresponding adjacent transect.

2.1.3 Soil aggregate stability

Surface soil aggregate stability was measured using a modified wet aggregate stability method (Herrick et al. 2005a). Within each plot, samples were collected at pre-determined points on either side of the six line-point intercept transects. A total of 48 uniformly sized (2–3 mm thick and 6–8 mm on each side) samples were tested per plot, in groups of 16. Each sample was placed on a screen and soaked in water for five minutes. After five minutes, the samples were slowly dipped up and down in the water, with the remaining amount of soil recorded as an index of the wet aggregate stability of the sample. Samples were scored from 1 to 6, with 6 being the most stable.

2.1.4 Soil and site characterization

Proximate soil and landform factors are known to influence vegetation and dynamic soil function parameters at local scales (McAuliffe 1999). To characterize the soil and landscape attributes of each plot, a suite of topographic variables was collected through site diagrams, repeat photo points, and collection of soil cores. Landform, slope position, and parent material were recorded at each plot. Flow-length diagrams were used to depict surface-flow patterns and document the slopes (%) and lengths (m) of the hillslope within and immediately upslope of each plot. Permanent photo points were established at each plot corner to characterize general site physiognomy and as an aid to interpreting quantitative trend data in successive sampling periods. In addition, general site descriptions (including observed disturbances, such as fire) were collected for each plot.

2.2 Sampling design

2.2.1 Overview

We allocated a total of 27 permanent monitoring plots in a spatially balanced arrangement (see Section 2.2.3), based on a priori expectations of required sample size to meet our criteria for statistical power and detectability (see Sections 2.2.5–2.2.6). Terrestrial vegetation and soils plots were proportionately allocated to four strata based on elevation and soil type (Figure 2-2, Table 2-1). Stratification (see Section 3.2.2, Hubbard et al. in review) was employed to reduce spatial variability and increase sampling efficiency.

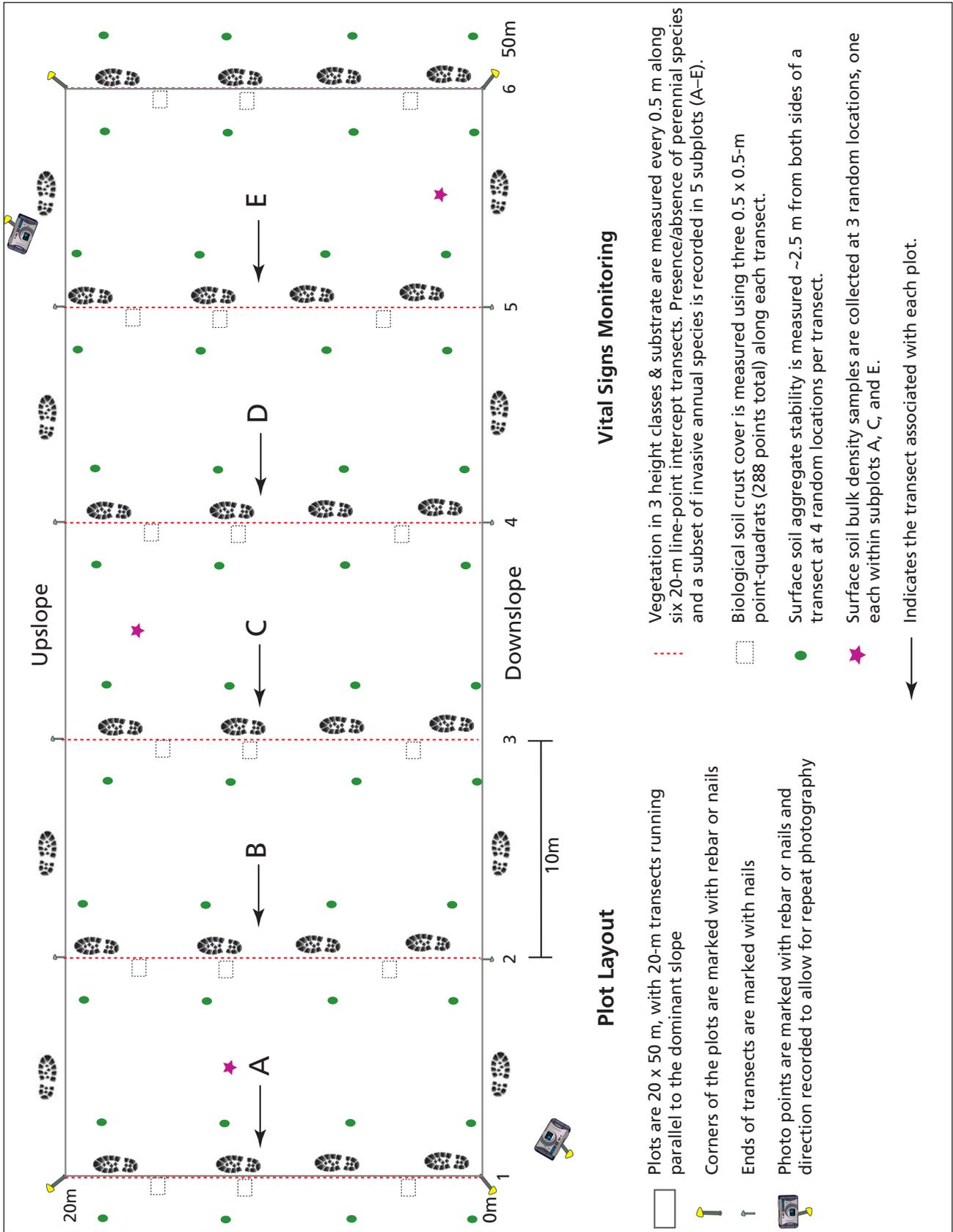


Figure 2-1. Terrestrial vegetation and soils monitoring plot design. See Hubbard and others (2009) for additional details on design and data collection.



Vegetation & Soils Monitoring Plots

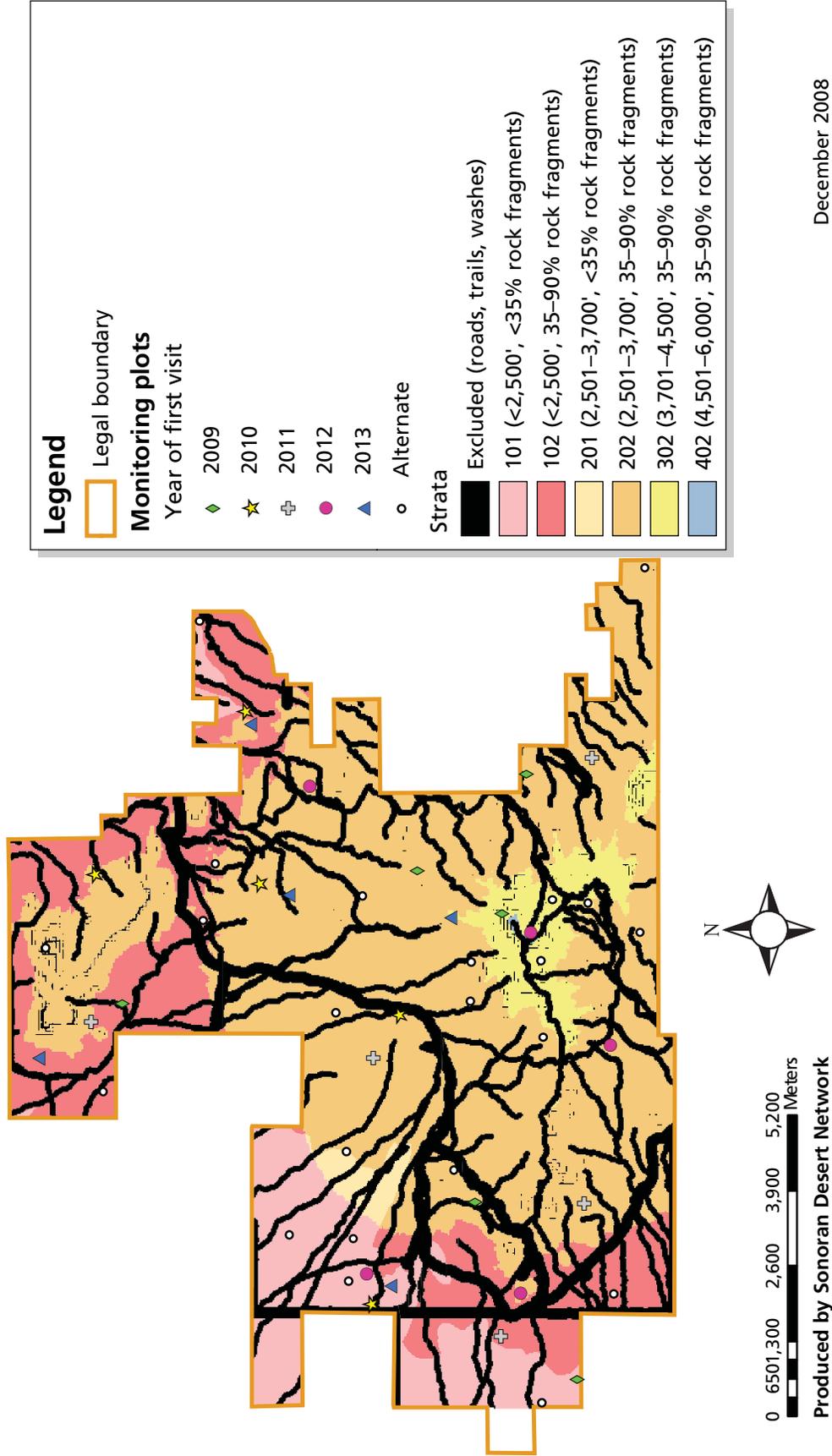


Figure 2-2. Distribution of terrestrial vegetation and soils monitoring plots at the Tucson Mountain District, Saguaro NP, 2009–2010.

Table 2-1. Allocation of permanent terrestrial vegetation and soils monitoring plots by strata, Saguaro NP–Tucson Mountain District, 2009–2010.

| Stratum | Elevation | % rock fragments | Total area (acres) | Percentage of total park area | Percentage of total frame area | Plots per stratum | |
|----------|--------------|------------------|--------------------|-------------------------------|--------------------------------|-------------------|-----------------|
| | | | | | | Total number | Number per year |
| Excluded | | | 6,618 | 27 | 0 | 0 | 0 |
| 101 | <2,500' | <35% | 2,193 | 9 | 12 | 3 | 0 or 1 |
| 102 | <2,500' | 35–90% | 3,351 | 14 | 19 | 5 | 1 |
| 201 | 2,501–3,700' | <35% | 224 | 0.9 | 1.2 | 0 | 0 |
| 202 | 2,501–3,700' | 35–90% | 11,205 | 45 | 62 | 16 | 3 or 4 |
| 302 | 3,701–4,500' | 35–90% | 1,036 | 4 | 6 | 2 | 0 or 1 |
| 402 | 4,501–6,000' | 35–90% | 7 | 0.03 | 0.04 | 0 | 0 |

Each stratum contains at least three plots. Strata containing <5% of the park area (i.e., 201 and 402) were excluded.

Because access is a concern at the unit, we used a cost-surface approach (Figure 2-3), based on modeled travel time, to adjust inclusion probabilities for sampling plots. Appendix A of the monitoring protocol (Hubbard et al. in review) provides the details; essentially, plot locations were weighted toward sites that were more accessible, although all locations had a chance of being selected (except those excluded due to safety concerns or possible harm to resources; see Section 2.2.4). Consequently, inference from the plots at Saguaro NP is to all terrestrial areas of the unit by elevation × soil strata, excepting the areas discussed in Section 2.2.4 below.

2.2.2 Annual sampling

Permanent plots were employed to increase our ability to efficiently detect trends, by explicitly partitioning spatial and temporal variability (Elzinga et al. 1998). As with all designs, there are inherent tradeoffs with using permanent plots, as discussed in Hubbard and others (in review). The primary disadvantage at larger units (such as the

TMD) is that sampling across landscapes (space) is reduced as field effort is dedicated to revisiting existing plots.

To ensure adequate spatial coverage, we employed a simple rotating panel design (McDonald 2003) that allocates plots annually, such that each plot is revisited every five years [1,4], in line with our assumptions regarding the timing of biologically meaningful change (Hubbard et al. in review). Using this approach, the total population of plots in a park is apportioned evenly per year. For the TMD, the total anticipated sample size is 26 plots; therefore, 5–6 plots are sampled each year (Table 2-2).

The advantages of this design are that (1) the influence of interannual variation (i.e., noise) is less pronounced for the analysis of five-year trends; and (2) there are tremendous efficiency gains, from the perspective of fielding and funding sampling crews, as effort is spread evenly over five-year intervals. The disadvantages are that (1) the effects of individual stochastic events may be

Table 2-2. Sampling schedule for Saguaro NP–Tucson Mountain District.

| Stratum | Year | | | | |
|---------------------------------|--------------|-------|----------|----------|----------|
| | Plot numbers | | | | |
| | 2009 | 2010 | 2011 | 2012 | 2013 |
| 101 (loamy soils, <2,501') | 1 | 2 | | | 3 |
| 102 (rocky soils, <2,501') | 1 | 2 | 3 | 4 | 5 |
| 202 (rocky soils, <3,700') | 1,2,3 | 4,5,6 | 7,8,9,10 | 11,12,13 | 14,15,16 |
| 302 (rocky soils, 3,701-4,500') | 2 | | | 3 | |

Values are the site labels within each stratum. Adjustments within and between strata may occur based on early results. Section 2.2.2 describes the stratification scheme.



Hiking Time to Monitoring Plots

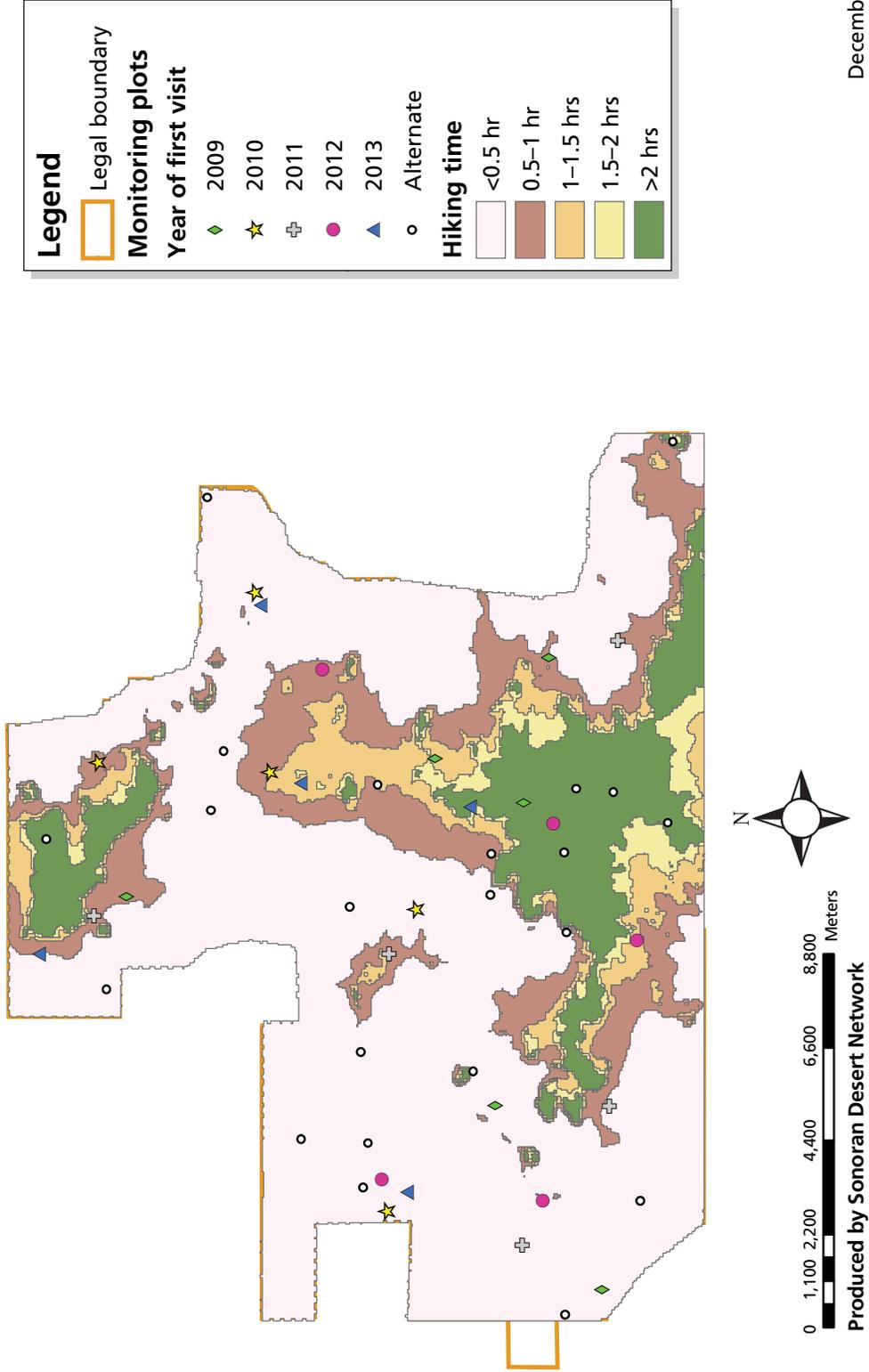


Figure 2-3. Modeled travel time relative to terrestrial vegetation and soil plot locations, Tucson Mountain District, Saguaro NP. Travel time was used to create a cost surface that weighted plot selection toward more accessible sites.

difficult to evaluate (Hubbard et al. in review) and (2) detecting trends requires at least 10 years of data collection (i.e., two sampling intervals for all plots). Rotating-panel designs generally allow trend detection over shorter time periods (particularly when a subset of the plots is monitored continually), but sampling intensity is unlikely to meet our statistical-power and species-detection goals (see Sections 2.5–2.6). We ruled out intensive annual monitoring of a subset of plots due to concerns over plot degradation, as discussed in the SODN natural and cultural resource compliance effort (NPS 2005b).

If a major disturbance (e.g., fire, extended periods of temperature extremes, mass soil movement) occurs in the intervening years, we may collect additional plot data to characterize and account for the potential effects of these important stochastic events.

2.2.3 Spatial balance

The spatial sampling design for this protocol employs permanent, 20 × 50-m sampling plots, allocated through a Reversed Randomized Quadrant-Recursive Raster (RRQRR) spatially balanced design (Theobald et al. 2007), using the “spatially balanced sample” function in the STARMAP Spatial Sampling Toolbox in ArcGIS 9.0 (<http://www.spatialecology.com/htools/index.php>). This tool produces a design that is spatially well-balanced, probability-based, flexible, and simple (Theobald et al. 2007). Because it tries to maximize the spatial independence between plots, the spatially-balanced sampling design should provide more information per plot, thus increasing efficiency (Theobald et al. 2007).

Spatially balanced designs, such as RRQRR (for polygon data) and the Generalized Random Tessellation Stratified (GRTS; for points and lines) approach (Stevens and Olsen 2004), are increasingly being applied to ecosystem monitoring (e.g., Environmental Protection Agency Ecological Monitoring and Assessment Program) because they provide the advantages of a probabilistic design (Stehman 1999) and ensure spatial balance regardless of overall sample size. RRQRR designs facilitate adding or removing sites in a spatially balanced manner if statistical power, financial considerations, or additional monitoring objectives warrant adjusting the sample size. This scaling ability is an important advantage, as (1) the number of plots per park cannot always be adequately estimated a priori (see Section 3.4.2,

Hubbard et al. in review) and (2) future changes in technology, objectives, and budgets may necessitate increasing or decreasing sample sizes.

2.2.4 Sampling frame

The sampling frame for the TMD (Figure 2-2) includes all terrestrial areas within unit boundaries, except for the following:

- Slopes of $\geq 45^\circ$ (for crew safety)
- Roads and buildings (including 100-m buffer)
- Trails, washes, and streams (including 50-m buffer)

The total area excluded under these criteria was 6,618 acres (~2,678 ha), or 27% of the unit area.

2.2.5 Management assessment points as the link between science and management

To achieve the National Park Service’s core mission of resource protection, resource management and monitoring must be explicitly linked (Bingham et al. 2007). We advocate the use of management assessment points as a bridge between science and management. Management assessment points are “pre-selected points along a continuum of resource-indicator values where scientists and managers have agreed to stop and assess the status or trend of a resource relative to program goals, natural variation, or potential concerns” (Bennetts et al. 2007).

Management assessment points therefore aid interpretation of ecological information within a management context. They do not define strict management or ecological thresholds, inevitably result in management actions, or reflect any legal or regulatory standard; they are only intended to serve as a potential early warning system allowing scientists and managers to pause, review the available information in detail, and consider options. Bennetts and others (2007) provided a detailed explanation of this concept and its application to monitoring and management of protected areas.

Although no management assessment points have been formally established for Saguaro NP, we intend to develop assessment points relevant to terrestrial vegetation and soils as part of the Natural Resource Condition Assessment (NRCA) process (see http://www.nature.nps.gov/water/NRCondition_Assessment_Program/Index.cfm). We expect the NRCA effort at Sa-

guaro NP to begin in 2012 or 2013, pending funding and approval from the National Park Service Water Resources Division. For an example of the application of management assessment points, see Terrestrial Vegetation and Soils Monitoring at Fort Bowie National Historic Site: 2008 Status Report (Hubbard et al. 2010), available at: http://science.nature.nps.gov/im/units/sodn/digital_library.cfm.

2.2.6 Statistical power to distinguish status from management assessment points

Estimating our statistical power to distinguish current conditions (i.e., status) from management assessment points (see previous section) is important for both protocol design (especially for determining adequate sample sizes) and data interpretation. Adequate sample size (number of plots) is estimated by (Herrick et al. 2005b):

$$n = \frac{(S)^2 (Z_{\alpha} + Z_{\beta})^2}{(MDC)^2}$$

Where:

S = standard deviation of the sample,

Z_{α} = Z-coefficient for false change (Type I) error (set at 90%),

Z_{β} = Z-coefficient for missed-change (Type II) error (set at 10%), and

MDC = minimum detectable change from the assessment point (set at 5–20%).

Bonham (1989), Elzinga and others (1998), and Herrick and others (2005b) provide detailed discussions of statistical power to detect differences from a standard.

2.2.7 Statistical power to detect trends

Statistical power is also important for evaluating trends (change over time) in monitoring parameters. Adequate sample size (number of plots) for detecting a trend of a given size across a landscape with permanent plots is estimated from:

$$n = \frac{(S_{diff})^2 (Z_{\alpha} + Z_{\beta})^2}{(MDC)^2}$$

Where:

S_{diff} = Standard deviation of the differences between paired samples,

Z_{α} = Z-coefficient for false change (Type I) error (set at 90%),

Z_{β} = Z-coefficient for missed-change (Type II) error (set at 10%), and

MDC = minimum detectable change size between time 1 and time 2 (set at 5–20%)

In this case, we only have one sampling interval, so we estimate “ S_{diff} ” using the following equation:

$$S_{diff} = (S_1)(\sqrt{2(1-corr_{diff})})$$

Where:

S_1 = Sample standard deviation among sampling units at first time period, and

$corr_{diff}$ = estimated correlation coefficient between time 1 and time 2, set at 0.75.

Bonham (1989), Elzinga and others (1998), and Herrick and others (2005b) provide detailed discussions of statistical power to detect trend.

2.2.8 Evaluation of strata

The terrestrial vegetation monitoring design apports long-term monitoring sites to strata to improve the efficiency of parkwide estimation of monitoring parameters of interest. It is assumed that vegetation and dynamic soil functional attributes respond differently to environmental factors that can be clearly defined and are immutable over management and monitoring timescales (Bonham 1989).

To evaluate the efficiency and pertinence of our preselected elevation strata, we contrasted the similarity of the vegetation communities on each stratum using Analysis of Similarity (ANOSIM) and non-metric multidimensional scaling (NMDS), non-parametric, multivariate community analysis techniques that make few assumptions about the data, yielding a simple yet powerful analysis tool (Clarke and Warwick 2001).

3 Results

3.1 Vegetation monitoring results

3.1.1 Provisional results

Results from these first two seasons showed that the field layer had the highest vegetation cover ($33.1 \pm 4.2\%$) and species richness (49 perennial species) of any layer. The subcanopy layer had less than half the cover and about 2/3 the perennial species of the field layer ($14.8 \pm 2.38\%$ and 30, respectively), and the canopy layer contained only $3.3 \pm 1.1\%$ cover from just eight species, reflecting the sparse, short statured nature of these aridland plant communities. No new species were detected during sampling. A data summary of provisional results is provided in Appendix A.

3.2 Evaluation of strata

Analysis of similarity (ANOSIM) results indicated few significant differences ($P < 10\%$) between plant communities in the four strata groupings by elevation and soils (Table 3-1). Field and subcanopy vegetation differed ($P \leq 9.8\%$) between sites below 2,501' with fine soils (101 stratum) and rocky sites between 2,501 and 3,700' elevation (202 stratum). Interestingly, soil type had no effect ($P \geq 33\%$) on similarities between sites at the same elevation (101 vs. 102). Non-metric multidimensional scaling (Figure 3-1) also suggested an important break in similarity between sites above and below 3,700'.

3.3 Estimates of power and species detectability

3.3.1 Power to detect trends in plant lifeforms and common perennial species

Our proposed sampling design met or exceeded our expectations for statistical power to detect trends in common perennial species based on our design criteria (i.e., to detect a 10% absolute change in foliar cover with 90% power and 10% chance of a false-change error). The only exception was *Ambrosia deltoidea*, in the subcanopy of the 102 stratum, in which we could detect an 11% change. Our data indicate that we will be able to detect a 5% or smaller change (absolute foliar cover) for nearly all detected perennial species with the current level of sampling intensity (see Appendix A).

Table 3-1. Analysis of similarity (ANOSIM) pairwise-test results for contrasting vegetation composition by strata for (a) canopy, (b) subcanopy, and (c) field height classes for terrestrial vegetation monitoring, Saguaro NP–Tucson Mountain District, 2009–2010.

a) Field (<0.5 m)

Global R: 0.666, P = 0.4%

| Groups | R | P |
|-------------|-------|-------------|
| 101 vs. 102 | 0.5 | 33.3% |
| 101 vs. 202 | 0.979 | 3.6% |
| 101 vs. 302 | 1 | 33.3% |
| 102 vs. 202 | 0.094 | 35.7% |
| 102 vs. 302 | 1 | 33.3% |
| 202 vs. 302 | 1 | 14.3% |

b) Subcanopy (0.5–2.0 m)

Global R: 0.341, P = 9.8%

| Groups | R | P |
|-------------|--------|--------|
| 101 vs. 102 | 0.125 | 66.7% |
| 101 vs. 202 | 0.521 | 10.7% |
| 101 vs. 302 | -0.5 | 100.0% |
| 102 vs. 202 | -0.208 | 82.1% |
| 102 vs. 302 | 1 | 33.3% |
| 202 vs. 302 | 0.9 | 14.3% |

c) Canopy (>2.0 m)

Global R: -0.052, P = 56.7%

| Groups | R | P |
|-------------|--------|--------|
| 101 vs. 102 | 0.25 | 33.3% |
| 101 vs. 202 | -0.12 | 82.1% |
| 101 vs. 302 | 0 | 100.0% |
| 102 vs. 202 | -0.267 | 89.3% |
| 102 vs. 302 | 1 | 33.3% |
| 202 vs. 302 | 0.214 | 28.6% |

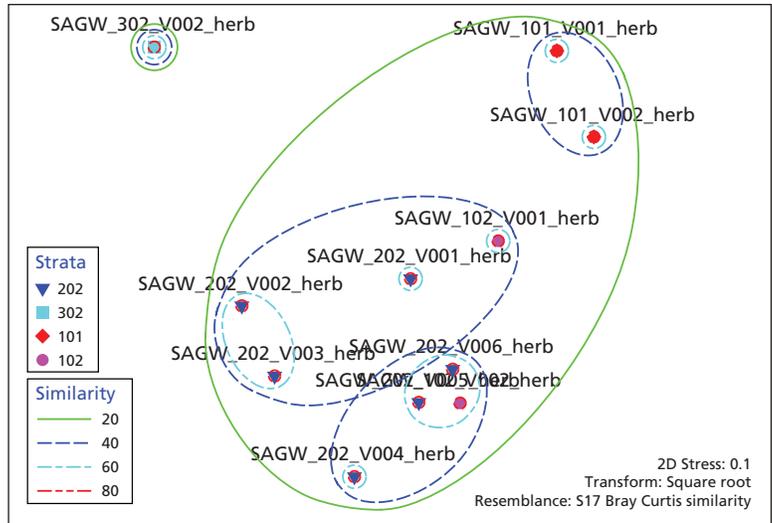
Bolded values are statistically significant at our selected P value threshold.

3.3.2 Power for trend in uncommon perennial species

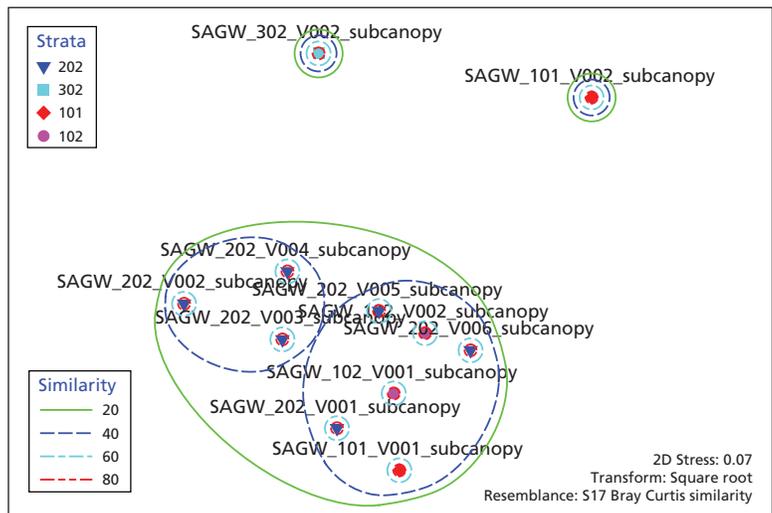
Our design met or exceeded our sampling objectives for detecting trends for many uncommon perennial species (i.e., to detect at least a 10% change in within-plot frequency with 90% power and 10% chance of false-change error) for species encountered only in frequency subplots.

Figure 3-1. Non-metric multidimensional scaling indicates similarity of (a) field, (b) subcanopy, and (c) canopy layer communities. The distance between any two points increases as their composition and structure differ.

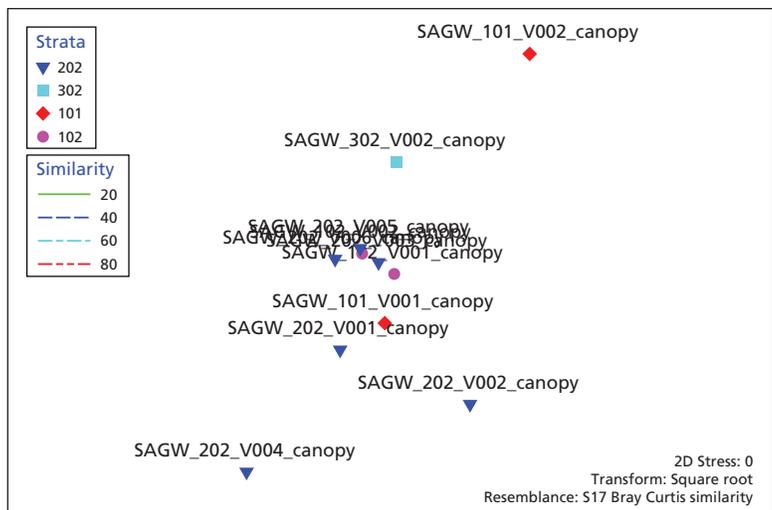
a) Field (<0.5 m)



b) Subcanopy (0.5–2.0 m)



c) Canopy (>2.0 m)



There was less power to detect change in 37 species with relatively high within-plot frequencies and high variance based on frequency (see Appendix A). However, all but four of those species (*Menodora scabra*, *Aloysia wrightii*, *Calliandra eriophylla*, and *Mammillaria grahamii*) were also detected as vegetation cover along the line-point transects, which provided far more precise estimates and improved statistical power than frequency (see Appendix A).

3.3.3 Plant species detectability

Line-point intercepts on the 11 monitoring sites sampled in 2009 and 2010 detected 55 perennial species. Employing the frequency subplots added 32 perennial species. Slope decreased markedly on species accumulation curves (Figure 3-2), suggesting diminishing returns for detecting new species with increased sampling intensity.

3.3.4 Power for trend in soil parameters

Our design met or exceeded our sampling objectives for most soil parameters (i.e., to detect at least a 10% change in within-plot frequency with 90% power and 10% chance of false-change error) at the proposed sampling intensity (see Appendix A). Exceptions were gravel cover across all strata, and rock and litter cover on coarse-textured sites in the 102 stratum. Soil stability met or exceeded our criteria for all strata; however, the percentage of “very stable” samples (another measure of stability) consistently failed to meet our criteria.

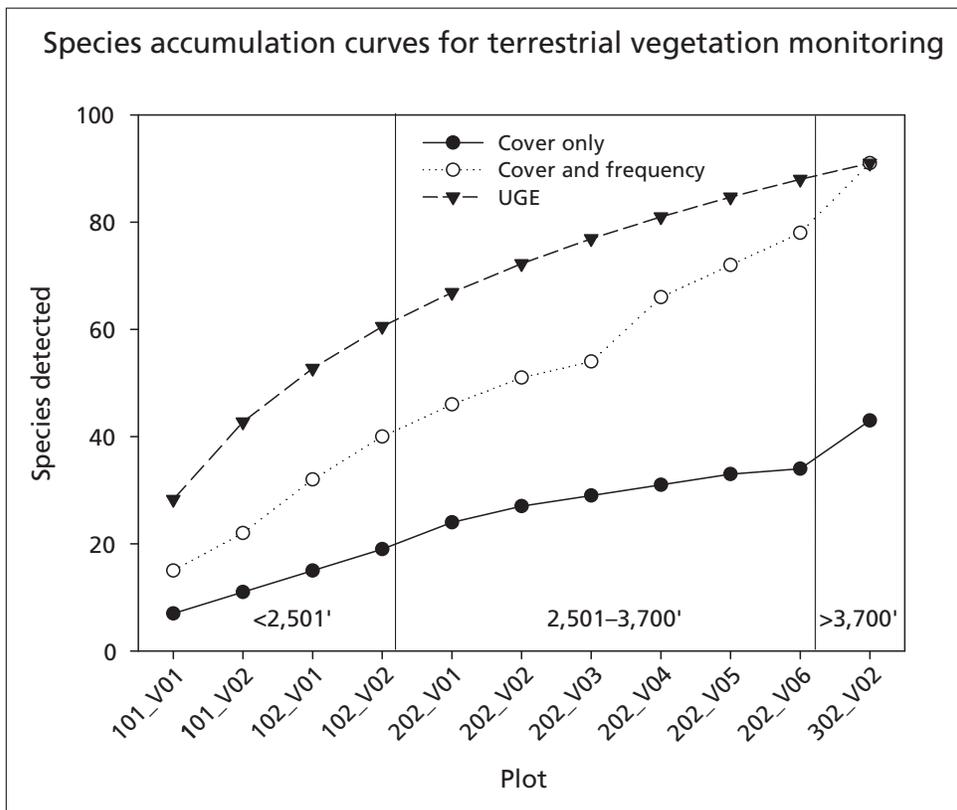


Figure 3-2. Species area curves for cover and frequency data collected on terrestrial vegetation and soils plots at Saguaro NP–Tucson Mountain District in 2009 and 2010. Curves show cumulative numbers of species detected as plots are added. UGE = mean species accumulation curve with samples entered in random order (Ugland et al. 2003).

4 Discussion

4.1 Are the strata effective?

Our results suggest that the vegetation communities of the Tucson Mountain District are not well-differentiated by our strata, with the exception of fine-textured low-elevation sites vs. rocky mid-elevation sites (stratum 101 vs. 202). In addition, non-metric multidimensional scaling (NMDS; see Figure 3-2) suggests that the high-elevation communities differ greatly from low- and mid-elevation sites, despite the lack of significance in the Analysis of Similarity (ANOSIM); see Appendix A.

It is likely that this lack of strata differentiation is an artifact of the small sample sizes of the smaller areas contained within limited strata. A key limitation of allocating samples to the year visited is that during the early years of the five-year rotation, only 1–2 plots are completed in the smaller strata (i.e., 302, 101, and 102, with only 2, 3, and 5 plots, respectively). These small sample sizes confound our assessments of the strata and species/lifeform power for restricted strata.

Alternatively, the vegetation communities may be similar enough to allow the strata to be combined. To evaluate which scenario is driving our results (limited sample size or a real lack of ecological differences between strata) we will (1) add one plot to the high-elevation (302) stratum and (2) shift the sampling schedule for the remaining plots forward to 2011. The proposed adjustments (Table 4-1) will allow us to better assess stratification and within-stratum statistical power before the five-year sampling period ends in 2013.

If sample sizes are not responsible for the similarity between strata, then we will combine strata. If combining strata is warranted, we could adjust

our sample sizes downward and save field effort and cost.

4.2 Does the sample size meet our criteria?

Estimated statistical power to detect change was excellent based on the proposed sample size. In fact, we were pleased and surprised that we at least met (and nearly always exceeded) our target criteria for change detection for perennial species, with the lone exception of *Ambrosia deltoidea*, which missed our criteria by only 1%. Aggregating species to lifeforms tends to decrease power by increasing the mean and variance. However, we still consistently met our power criteria for lifeforms.

Sample size for statistical power is excellent and does not require any adjustments; however, it is likely that we are actually oversampling rocky sites between 2,501 and 3,700' in elevation—a rare situation in any ecological study. If additional sampling in 2011 suggests that this is the case, we may reduce our sampling intensity in the future, saving field effort that can be applied to other high-priority monitoring needs.

We detected only 87 (17%) of the 512 known species in the Tucson Mountain District of Saguaro NP (Powell et al. 2007). However, less than 50% of the sites have been sampled; our sampling frame excludes aquatic, riparian, and xeroriparian sites that are biodiversity hotspots; and annuals are not identified to species. In addition, the flattening of the species accumulation curve suggested that our species detectability was quite reasonable. As a result, we do not recommend any increases in sample size for species detectability at this time. We will reassess this conclusion annually in future data summaries.

Table 4-1. Adjusted sampling schedule for Saguaro NP–Tucson Mountain District.

| Strata | Year | | | | |
|---------------------------------|--------------|---------|------|----------------------|----------------|
| | Plot numbers | | | | |
| | 2009 | 2010 | 2011 | 2012 | 2013 |
| 101 (loamy soils, <2,501') | 1 | 2 | 3 | - | - |
| 102 (rocky soils, <2,501') | 1 | 2 | 3, 4 | - | 5 |
| 202 (rocky soils, <3,700') | 1, 2, 3 | 4, 5, 6 | 7 | 8, 9, 10, 11, 12, 13 | 13, 14, 15, 16 |
| 302 (rocky soils, 3,701–4,500') | 2 | - | 3, 4 | - | - |

Adjustments within and between strata may occur based on early results. Section 2.2.2 describes the stratification scheme.

4.3 Implications for terrestrial vegetation and soils monitoring

This effort entailed some of the first terrestrial vegetation and soils monitoring in the SODN. Therefore, much of our focus was on evaluating the efficacy of the sampling and response designs to support improvement of the protocol. We found the plot sampling design to be efficient: most plots were sampled within 2–4 hours, including tasks that will not need to be repeated in successive visits (e.g., initial plot layout, permanent marking and mapping, and collection of in situ soil and landscape parameters). Most sites were relatively accessible for day trips, and only one of 11 plots surveyed to date failed to meet our sampling criteria due to excessive slope.

After comparing these results with our monitoring objectives, we conclude that the sampling design is appropriate (perhaps even excessive, based on our criteria). We will adjust our sampling program in 2011 to better evaluate the value of stratification, so as to permit further adjustments as necessary before the completion of the five-year sampling period in 2013.

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Appendix A. Supplementary Data Tables

Unless otherwise noted, the following categories and notations apply throughout this appendix:

| Stratum | Elevation | Description | Number of plots |
|---------|---------------|-------------------------|-----------------|
| 101 | <2,501' | Loamy | 3 |
| 102 | <2,501' | Very to Extremely Rocky | 5 |
| 202 | 2,501'–3,700' | Very to Extremely Rocky | 16 |
| 302 | 3,701–4,500' | Very to Extremely Rocky | 3 |

| Layer | Stature |
|-----------|-----------|
| Field | <0.5 m |
| Subcanopy | 0.5–2.0 m |
| Canopy | >2.0 m |

- AVG = average
- MDC = minimum detectable change (% cover)
- n = required number of plots for power criteria
- SD = standard deviation
- Sdiff = standard deviation of the differences
- SE = standard error
- Highlighted species failed to meet our statistical power criteria.

Table A1a. Within-plot cover values (%) for species measured in the field layer of terrestrial vegetation and soils plots, 101 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| Species | Individual plot measures | | Across-plot measures | | | | | |
|--------------------------------------|--------------------------|---------|----------------------|------|------|-------|-----|----|
| | 2009 | 2010 | AVG | STD | SE | Sdiff | MDC | n= |
| | 101_V01 | 101_V02 | | | | | | |
| Forb/Herb | | | | | | | | |
| <i>Artemisia ludoviciana</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Carlowrightia arizonica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Selaginella arizonica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Tragia ramosa</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Graminoid | | | | | | | | |
| <i>Aristida purpurea</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Aristida ternipes</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Bouteloua curtipendula</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Digitaria californica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Hilaria mutica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Leptochloa dubia</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Muhlenbergia porteri</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Subshrub | | | | | | | | |
| <i>Abutilon incanum</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Ambrosia deltoidea</i> | 7.1% | 10.4% | 8.8% | 2.4% | 1.7% | 1.7% | 5% | 1 |
| <i>Argythamnia lanceolata</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Baccharis brachyphylla</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Encelia farinosa</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Eriogonum wrightii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Koanophyllon solidaginifolium</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Krameria grayi</i> | 0.0% | 0.8% | 0.4% | 0.6% | 0.4% | 0.4% | 5% | 1 |
| <i>Menodora scabra</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Sphaeralcea</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Trixis californica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Shrub | | | | | | | | |
| <i>Aloysia wrightii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Atriplex canescens</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Calliandra eriophylla</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Celtis ehrenbergiana</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Ephedra trifurca</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Jatropha cardiophylla</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Larrea tridentata</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Lycium andersonii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Lycium berlandieri</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Matelea parvifolia</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Simmondsia chinensis</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |

Table A1a. Within-plot cover values (%) for species measured in the field layer of terrestrial vegetation and soils plots, 101 stratum, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Species | Individual plot measures | | Across-plot measures | | | | | |
|------------------------------------|--------------------------|---------|----------------------|------|------|-------|-----|----|
| | 2009 | 2010 | AVG | STD | SE | Sdiff | MDC | n= |
| | 101_V01 | 101_V02 | | | | | | |
| Succulent | | | | | | | | |
| <i>Agave schottii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Carnegiea gigantea</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Cylindropuntia acanthocarpa</i> | 0.0% | 1.3% | 0.6% | 0.9% | 0.6% | 0.6% | 5% | 1 |
| <i>Cylindropuntia arbuscula</i> | 2.5% | 0.8% | 1.7% | 1.2% | 0.8% | 0.8% | 5% | 1 |
| <i>Cylindropuntia bigelovii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Dasyllirion wheeleri</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Ferocactus wislizeni</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Fouquieria splendens</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Opuntia engelmannii</i> | 0.0% | 0.4% | 0.2% | 0.3% | 0.2% | 0.2% | 5% | 1 |
| <i>Opuntia phaeacantha</i> | 0.0% | 0.8% | 0.4% | 0.6% | 0.4% | 0.4% | 5% | 1 |
| Tree | | | | | | | | |
| <i>Acacia constricta</i> | 0.4% | 0.0% | 0.2% | 0.3% | 0.2% | 0.2% | 5% | 1 |
| <i>Acacia greggii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Celtis laevigata</i> | 1.7% | 0.0% | 0.8% | 1.2% | 0.8% | 0.8% | 5% | 1 |
| <i>Parkinsonia microphylla</i> | 0.4% | 0.0% | 0.2% | 0.3% | 0.2% | 0.2% | 5% | 1 |
| <i>Vauquelinia californica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Vine | | | | | | | | |
| <i>Janusia gracilis</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Totals by lifeform | | | | | | | | |
| Annual Forb | 0.0% | 0.4% | 0.2% | 0.3% | 0.2% | 0.2% | 5% | 1 |
| Annual Grass | 0.0% | 1.3% | 0.6% | 0.9% | 0.6% | 0.6% | 5% | 1 |
| Perennial Forb | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Perennial Grass | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Subshrub | 7.08% | 11.25% | 9.2% | 2.9% | 2.1% | 2.1% | 5% | 2 |
| Shrub | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Succulent | 2.50% | 3.33% | 2.9% | 0.6% | 0.4% | 0.4% | 5% | 1 |
| Tree | 2.50% | 0.00% | 1.3% | 1.8% | 1.3% | 1.3% | 5% | 1 |
| Snag | 2.1% | 3.8% | 2.9% | 1.2% | 0.8% | 0.8% | 5% | 1 |
| Vine | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Total | 12.08% | 16.25% | 14.2% | 2.9% | 2.1% | 2.1% | 5% | 2 |

Table A1b. Within-plot cover values (%) for species measured in the field layer of terrestrial vegetation and soils plots, 102 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| Species | Individual plot measures | | Across-plot measures | | | | | |
|--------------------------------------|--------------------------|---------|----------------------|-------|------|-------|-----|----|
| | 2009 | 2010 | AVG | STD | SE | Sdiff | MDC | n= |
| | 102_V01 | 102_V02 | | | | | | |
| Forb/Herb | | | | | | | | |
| <i>Artemisia ludoviciana</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Carlowrightia arizonica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Selaginella arizonica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Tragia ramosa</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Graminoid | | | | | | | | |
| <i>Aristida purpurea</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Aristida ternipes</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Bouteloua curtipendula</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Digitaria californica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Hilaria mutica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Leptochloa dubia</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Muhlenbergia porteri</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Subshrub | | | | | | | | |
| <i>Abutilon incanum</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Ambrosia deltoidea</i> | 15.8% | 0.4% | 8.1% | 10.9% | 7.7% | 7.7% | 11% | 5 |
| <i>Argythamnia lanceolata</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Baccharis brachyphylla</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Encelia farinosa</i> | 1.7% | 3.8% | 2.7% | 1.5% | 1.0% | 1.0% | 5% | 1 |
| <i>Eriogonum wrightii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Koanophyllon solidaginifolium</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Krameria grayi</i> | 0.0% | 0.8% | 0.4% | 0.6% | 0.4% | 0.4% | 5% | 1 |
| <i>Menodora scabra</i> | 0.8% | 0.4% | 0.6% | 0.3% | 0.2% | 0.2% | 5% | 1 |
| <i>Sphaeralcea</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Trixis californica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Shrub | | | | | | | | |
| <i>Aloysia wrightii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Atriplex canescens</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Calliandra eriophylla</i> | 0.4% | 3.3% | 1.9% | 2.1% | 1.5% | 1.5% | 5% | 1 |
| <i>Celtis ehrenbergiana</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Ephedra trifurca</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Jatropha cardiophylla</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Larrea tridentata</i> | 0.0% | 0.8% | 0.4% | 0.6% | 0.4% | 0.4% | 5% | 1 |
| <i>Lycium andersonii</i> | 0.8% | 0.0% | 0.4% | 0.6% | 0.4% | 0.4% | 5% | 1 |
| <i>Lycium berlandieri</i> | 0.0% | 2.1% | 1.0% | 1.5% | 1.0% | 1.0% | 5% | 1 |
| <i>Matelea parvifolia</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Simmondsia chinensis</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |

Table A1b. Within-plot cover values (%) for species measured in the field layer of terrestrial vegetation and soils plots, 102 stratum, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Species | Individual plot measures | | Across-plot measures | | | | | |
|------------------------------------|--------------------------|---------|----------------------|------|------|-------|-----|----|
| | 2009 | 2010 | AVG | STD | SE | Sdiff | MDC | n= |
| | 102_V01 | 102_V02 | | | | | | |
| Succulent | | | | | | | | |
| <i>Agave schottii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Carnegiea gigantea</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Cylindropuntia acanthocarpa</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Cylindropuntia arbuscula</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Cylindropuntia bigelovii</i> | 0.4% | 0.0% | 0.2% | 0.3% | 0.2% | 0.2% | 5% | 1 |
| <i>Dasyliirion wheeleri</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Ferocactus wislizeni</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Fouquieria splendens</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Opuntia engelmannii</i> | 0.0% | 0.4% | 0.2% | 0.3% | 0.2% | 0.2% | 5% | 1 |
| <i>Opuntia phaeacantha</i> | 0.0% | 8.3% | 4.2% | 5.9% | 4.2% | 4.2% | 6% | 5 |
| Tree | | | | | | | | |
| <i>Acacia constricta</i> | 0.4% | 1.7% | 1.0% | 0.9% | 0.6% | 0.6% | 5% | 1 |
| <i>Acacia greggii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Celtis laevigata</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Parkinsonia microphylla</i> | 2.5% | 2.1% | 2.3% | 0.3% | 0.2% | 0.2% | 5% | 1 |
| <i>Vauquelinia californica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Vine | | | | | | | | |
| <i>Janusia gracilis</i> | 2.1% | 0.8% | 1.5% | 0.9% | 0.6% | 0.6% | 5% | 1 |
| Totals by lifeform | | | | | | | | |
| Annual Forb | 0.0% | 6.3% | 3.1% | 4.4% | 3.1% | 3.1% | 5% | 4 |
| Annual Grass | 0.0% | 0.8% | 0.4% | 0.6% | 0.4% | 0.4% | 5% | 1 |
| Perennial Forb | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Perennial Grass | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Subshrub | 18.33% | 5.42% | 11.9% | 9.1% | 6.5% | 6.5% | 9% | 5 |
| Shrub | 1.25% | 6.25% | 3.8% | 3.5% | 2.5% | 2.5% | 5% | 3 |
| Succulent | 0.42% | 8.75% | 4.6% | 5.9% | 4.2% | 4.2% | 6% | 5 |
| Tree | 2.92% | 3.75% | 3.3% | 0.6% | 0.4% | 0.4% | 5% | 1 |
| Snag | 7.9% | 5.4% | 6.7% | 1.8% | 1.3% | 1.3% | 5% | 1 |
| Vine | 2.08% | 0.83% | 1.5% | 0.9% | 0.6% | 0.6% | 5% | 1 |
| Total | 25.00% | 32.08% | 28.5% | 5.0% | 3.5% | 3.5% | 5% | 5 |

Table A1c. Within-plot cover values (%) for species measured in the field layer of terrestrial vegetation and soils plots, 202 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| Species | Individual plot measures | | | | | Across-plot measures | | | | | | |
|--------------------------------------|--------------------------|---------|---------|---------|---------|----------------------|------|------|-------|-----|----|---------|
| | 2009 | | 2010 | | | AVG | STD | SE | Sdiff | MDC | n= | |
| | 202_V01 | 202_V02 | 202_V03 | 202_V04 | 202_V05 | | | | | | | 202_V06 |
| Forb/Herb | | | | | | | | | | | | |
| <i>Artemisia ludoviciana</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 | |
| <i>Carlwrightia arizonica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.4% | 0.0% | 0.1% | 0.1% | 0.1% | 5% | 1 | |
| <i>Selaginella arizonica</i> | 0.0% | 0.0% | 0.0% | 11.7% | 1.7% | 0.0% | 2.2% | 4.7% | 3.3% | 5% | 4 | |
| <i>Tragia ramosa</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 | |
| Graminoid | | | | | | | | | | | | |
| <i>Aristida purpurea</i> | 0.0% | 0.0% | 0.4% | 0.0% | 0.0% | 0.0% | 0.1% | 0.2% | 0.1% | 5% | 1 | |
| <i>Aristida ternipes</i> | 0.4% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | 0.2% | 0.1% | 5% | 1 | |
| <i>Bouteloua curtipendula</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 | |
| <i>Digitaria californica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 | |
| <i>Hilaria mutica</i> | 1.3% | 2.9% | 14.6% | 0.0% | 0.0% | 0.0% | 3.1% | 5.7% | 4.1% | 5% | 6 | |
| <i>Leptochloa dubia</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 | |
| <i>Muhlenbergia porteri</i> | 0.0% | 0.0% | 0.0% | 0.8% | 1.7% | 0.0% | 0.4% | 0.7% | 0.5% | 5% | 1 | |
| Subshrub | | | | | | | | | | | | |
| <i>Abutilon incanum</i> | 2.9% | 5.4% | 2.1% | 0.4% | 0.0% | 0.4% | 1.9% | 2.1% | 1.5% | 5% | 1 | |
| <i>Ambrosia deltoidea</i> | 5.8% | 0.0% | 0.0% | 0.4% | 0.0% | 1.7% | 1.3% | 2.3% | 1.6% | 5% | 1 | |
| <i>Argythamnia lanceolata</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.4% | 0.1% | 0.2% | 0.1% | 5% | 1 | |
| <i>Baccharis brachyphylla</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.8% | 0.0% | 0.1% | 0.3% | 0.2% | 5% | 1 | |
| <i>Encelia farinosa</i> | 2.1% | 0.0% | 2.1% | 0.8% | 1.7% | 3.3% | 1.7% | 1.1% | 0.8% | 5% | 1 | |
| <i>Eriogonum wrightii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 | |
| <i>Koanophyllon solidaginifolium</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.4% | 0.0% | 0.1% | 0.2% | 0.1% | 5% | 1 | |
| <i>Krameria grayi</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.8% | 0.0% | 0.1% | 0.3% | 0.2% | 5% | 1 | |
| <i>Menodora scabra</i> | 0.0% | 0.8% | 2.1% | 0.0% | 0.4% | 0.0% | 0.6% | 0.8% | 0.6% | 5% | 1 | |
| <i>Sphaeralcea</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 | |
| <i>Trixis californica</i> | 1.3% | 0.0% | 0.0% | 0.0% | 0.4% | 0.0% | 0.3% | 0.5% | 0.4% | 5% | 1 | |

Table A1c. Within-plot cover values (%) for species measured in the field layer of terrestrial vegetation and soils plots, 202 stratum, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Species | Individual plot measures | | | | | Across-plot measures | | | | | |
|--------------------------------|--------------------------|---------------|---------------|---------------|---------------|----------------------|-------------|-------------|-------------|-----------|----------|
| | 2009 | | 2010 | | | AVG | STD | SE | Sdiff | MDC | n= |
| | 202_V01 | 202_V02 | 202_V03 | 202_V04 | 202_V05 | | | | | | |
| Tree | | | | | | | | | | | |
| <i>Acacia constricta</i> | 2.9% | 0.8% | 2.9% | 0.0% | 0.8% | 0.8% | 1.2% | 0.5% | 0.9% | 5% | 1 |
| <i>Acacia greggii</i> | 0.0% | 1.3% | 1.3% | 0.4% | 0.0% | 0.0% | 0.6% | 0.3% | 0.4% | 5% | 1 |
| <i>Celtis laevigata</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Parkinsonia microphylla</i> | 1.7% | 0.0% | 0.4% | 0.0% | 1.7% | 1.3% | 0.8% | 0.3% | 0.6% | 5% | 1 |
| <i>Vauquelinia californica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Vine | | | | | | | | | | | |
| <i>Janusia gracilis</i> | 3.3% | 8.3% | 2.1% | 1.7% | 3.3% | 5.8% | 2.5% | 1.0% | 1.8% | 5% | 2 |
| Totals by lifeform | | | | | | | | | | | |
| Annual Forb | 0.0% | 0.4% | 0.8% | 10.0% | 7.1% | 12.5% | 5.5% | 2.2% | 3.9% | 5% | 6 |
| Annual Grass | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Perennial Forb | 0.00% | 0.00% | 0.00% | 11.67% | 2.08% | 0.00% | 4.7% | 1.9% | 3.3% | 5% | 4 |
| Perennial Grass | 1.67% | 2.92% | 15.00% | 0.83% | 1.67% | 0.00% | 5.6% | 2.3% | 4.0% | 5% | 6 |
| Subshrub | 12.08% | 6.25% | 6.25% | 1.67% | 4.58% | 5.83% | 3.4% | 1.4% | 2.4% | 5% | 2 |
| Shrub | 8.75% | 13.75% | 10.00% | 14.17% | 6.67% | 8.33% | 3.0% | 1.2% | 2.2% | 5% | 2 |
| Succulent | 0.83% | 2.50% | 0.83% | 0.00% | 3.75% | 0.42% | 1.4% | 0.6% | 1.0% | 5% | 1 |
| Tree | 4.58% | 2.08% | 4.58% | 0.42% | 2.50% | 2.08% | 1.6% | 0.7% | 1.1% | 5% | 1 |
| Snag | 4.2% | 2.1% | 2.1% | 2.9% | 19.2% | 12.9% | 7.2% | 2.9% | 5.1% | 5% | 9 |
| Vine | 3.33% | 8.33% | 2.08% | 1.67% | 3.33% | 5.83% | 2.5% | 1.0% | 1.8% | 5% | 2 |
| Total | 31.25% | 036.25 | 39.58% | 40.42% | 31.67% | 35.00% | 3.9% | 1.6% | 2.7% | 5% | 3 |

Table A1d. Within-plot cover values (%) for species measured in the field layer of terrestrial vegetation and soils plots, 302 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| Species | 2009 | Across-plot measures | | | | | |
|--------------------------------------|---------|----------------------|-----|-----|-------|-----|-----|
| | 302_V02 | AVG | STD | SE | Sdiff | MDC | n= |
| Forb/Herb | | | | | | | |
| <i>Artemisia ludoviciana</i> | 5.8% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Carlowrightia arizonica</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Selaginella arizonica</i> | 0.4% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Tragia ramosa</i> | 0.4% | n/a | n/a | n/a | n/a | 5% | n/a |
| Graminoid | | | | | | | |
| <i>Aristida purpurea</i> | 0.4% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Aristida ternipes</i> | 4.2% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Bouteloua curtipendula</i> | 12.9% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Digitaria californica</i> | 7.5% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Hilaria mutica</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Leptochloa dubia</i> | 0.8% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Muhlenbergia porteri</i> | 6.3% | n/a | n/a | n/a | n/a | 5% | n/a |
| Subshrub | | | | | | | |
| <i>Abutilon incanum</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Ambrosia deltoidea</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Argythamnia lanceolata</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Baccharis brachyphylla</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Encelia farinosa</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Eriogonum wrightii</i> | 2.1% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Koanophyllon solidaginifolium</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Krameria grayi</i> | 0.4% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Menodora scabra</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Sphaeralcea</i> | 0.4% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Trixis californica</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| Shrub | | | | | | | |
| <i>Aloysia wrightii</i> | 3.3% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Atriplex canescens</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Calliandra eriophylla</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Celtis ehrenbergiana</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Ephedra trifurca</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Jatropha cardiophylla</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Larrea tridentata</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Lycium andersonii</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Lycium berlandieri</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Matelea parvifolia</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Simmondsia chinensis</i> | 3.3% | n/a | n/a | n/a | n/a | 5% | n/a |

Table A1d. Within-plot cover values (%) for species measured in the field layer of terrestrial vegetation and soils plots, 302 stratum, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Species | 2009 | Across-plot measures | | | | | |
|------------------------------------|---------|----------------------|-----|-----|-------|-----|-----|
| | 302_V02 | AVG | STD | SE | Sdiff | MDC | n= |
| Succulent | | | | | | | |
| <i>Agave schottii</i> | 0.4% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Carnegiea gigantea</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Cylindropuntia acanthocarpa</i> | 2.1% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Cylindropuntia arbuscula</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Cylindropuntia bigelovii</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Dasyliroides wheeleri</i> | 3.3% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Ferocactus wislizeni</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Fouquieria splendens</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Opuntia engelmannii</i> | 6.3% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Opuntia phaeacantha</i> | 0.8% | n/a | n/a | n/a | n/a | 5% | n/a |
| Tree | | | | | | | |
| <i>Acacia constricta</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Acacia greggii</i> | 1.7% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Celtis laevigata</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Parkinsonia microphylla</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Vauquelinia californica</i> | 1.7% | n/a | n/a | n/a | n/a | 5% | n/a |
| Vine | | | | | | | |
| <i>Janusia gracilis</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| Totals by lifeform | | | | | | | |
| Annual Forb | 0.4% | n/a | n/a | n/a | n/a | 5% | n/a |
| Annual Grass | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| Perennial Forb | 6.67% | n/a | n/a | n/a | n/a | 5% | n/a |
| Perennial Grass | 32.08% | n/a | n/a | n/a | n/a | 5% | n/a |
| Subshrub | 2.92% | n/a | n/a | n/a | n/a | 5% | n/a |
| Shrub | 6.67% | n/a | n/a | n/a | n/a | 5% | n/a |
| Succulent | 12.92% | n/a | n/a | n/a | n/a | 5% | n/a |
| Tree | 3.33% | n/a | n/a | n/a | n/a | 5% | n/a |
| Snag | 1.3% | n/a | n/a | n/a | n/a | 5% | n/a |
| Vine | 0.00% | n/a | n/a | n/a | n/a | 5% | n/a |
| Total | 65.00% | n/a | n/a | n/a | n/a | 5% | n/a |

Table A1e. Within-plot cover values (%) for species measured in the field layer of terrestrial vegetation and soils plots, all strata, Tucson Mountain District, Saguaro NP, 2009–2010.

| Species | AVG | STD | SE | Sdiff | MDC | n= |
|--------------------------------------|------|-------|-------|-------|-----|----|
| Forb/Herb | | | | | | |
| <i>Artemisia ludoviciana</i> | 0.5% | 1.76% | 0.53% | 1.2% | 5% | 1 |
| <i>Carlowrightia arizonica</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| <i>Selaginella arizonica</i> | 1.3% | 3.49% | 1.05% | 2.5% | 5% | 3 |
| <i>Tragia ramosa</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| Graminoid | | | | | | |
| <i>Aristida purpurea</i> | 0.1% | 0.17% | 0.05% | 0.1% | 5% | 1 |
| <i>Aristida ternipes</i> | 0.4% | 1.25% | 0.38% | 0.9% | 5% | 1 |
| <i>Bouteloua curtipendula</i> | 1.2% | 3.89% | 1.17% | 2.8% | 5% | 3 |
| <i>Digitaria californica</i> | 0.7% | 2.26% | 0.68% | 1.6% | 5% | 1 |
| <i>Hilaria mutica</i> | 1.7% | 4.37% | 1.32% | 3.1% | 5% | 4 |
| <i>Leptochloa dubia</i> | 0.1% | 0.25% | 0.08% | 0.2% | 5% | 1 |
| <i>Muhlenbergia porteri</i> | 0.8% | 1.89% | 0.57% | 1.3% | 5% | 1 |
| Subshrub | | | | | | |
| <i>Abutilon incanum</i> | 1.0% | 1.76% | 0.53% | 1.2% | 5% | 1 |
| <i>Ambrosia deltoidea</i> | 3.8% | 5.37% | 1.62% | 3.8% | 5% | 5 |
| <i>Argythamnia lanceolata</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| <i>Baccharis brachyphylla</i> | 0.1% | 0.25% | 0.08% | 0.2% | 5% | 1 |
| <i>Encelia farinosa</i> | 1.4% | 1.36% | 0.41% | 1.0% | 5% | 1 |
| <i>Eriogonum wrightii</i> | 0.2% | 0.63% | 0.19% | 0.4% | 5% | 1 |
| <i>Koanophyllon solidaginifolium</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| <i>Krameria grayi</i> | 0.3% | 0.39% | 0.12% | 0.3% | 5% | 1 |
| <i>Menodora scabra</i> | 0.4% | 0.65% | 0.19% | 0.5% | 5% | 1 |
| <i>Sphaeralcea</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| <i>Trixis californica</i> | 0.2% | 0.39% | 0.12% | 0.3% | 5% | 1 |
| Shrub | | | | | | |
| <i>Aloysia wrightii</i> | 0.3% | 1.01% | 0.30% | 0.7% | 5% | 1 |
| <i>Atriplex canescens</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| <i>Calliandra eriophylla</i> | 2.4% | 2.71% | 0.82% | 1.9% | 5% | 2 |
| <i>Celtis ehrenbergiana</i> | 0.1% | 0.25% | 0.08% | 0.2% | 5% | 1 |
| <i>Ephedra trifurca</i> | 0.1% | 0.25% | 0.08% | 0.2% | 5% | 1 |
| <i>Jatropha cardiophylla</i> | 0.1% | 0.25% | 0.08% | 0.2% | 5% | 1 |
| <i>Larrea tridentata</i> | 0.1% | 0.25% | 0.08% | 0.2% | 5% | 1 |
| <i>Lycium andersonii</i> | 0.2% | 0.29% | 0.09% | 0.2% | 5% | 1 |
| <i>Lycium berlandieri</i> | 0.9% | 1.34% | 0.40% | 0.9% | 5% | 1 |
| <i>Matelea parvifolia</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| <i>Simmondsia chinensis</i> | 2.8% | 4.41% | 1.33% | 3.1% | 5% | 4 |

Table A1e. Within-plot cover values (%) for species measured in the field layer of terrestrial vegetation and soils plots, all strata, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Species | AVG | STD | SE | Sdiff | MDC | n= |
|------------------------------------|--------------|---------------|--------------|-------------|-----------|-----------|
| Succulent | | | | | | |
| <i>Agave schottii</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| <i>Carnegiea gigantea</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| <i>Cylindropuntia acanthocarpa</i> | 0.6% | 0.88% | 0.27% | 0.6% | 5% | 1 |
| <i>Cylindropuntia arbuscula</i> | 0.3% | 0.77% | 0.23% | 0.5% | 5% | 1 |
| <i>Cylindropuntia bigelovii</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| <i>Dasyliirion wheeleri</i> | 0.3% | 1.01% | 0.30% | 0.7% | 5% | 1 |
| <i>Ferocactus wislizeni</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| <i>Fouquieria splendens</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| <i>Opuntia engelmannii</i> | 1.0% | 1.83% | 0.55% | 1.3% | 5% | 1 |
| <i>Opuntia phaeacantha</i> | 0.9% | 2.48% | 0.75% | 1.8% | 5% | 2 |
| Tree | | | | | | |
| <i>Acacia constricta</i> | 1.0% | 1.07% | 0.32% | 0.8% | 5% | 1 |
| <i>Acacia greggii</i> | 0.4% | 0.65% | 0.19% | 0.5% | 5% | 1 |
| <i>Celtis laevigata</i> | 0.2% | 0.50% | 0.15% | 0.4% | 5% | 1 |
| <i>Parkinsonia microphylla</i> | 0.9% | 0.95% | 0.29% | 0.7% | 5% | 1 |
| <i>Vauquelinia californica</i> | 0.2% | 0.50% | 0.15% | 0.4% | 5% | 1 |
| Vine | | | | | | |
| <i>Janusia gracilis</i> | 2.5% | 2.63% | 0.79% | 1.9% | 5% | 2 |
| Totals by lifeform | | | | | | |
| Annual Forb | 3.4% | 4.65% | 1.40% | 3.3% | 5% | 4 |
| Annual Grass | 0.2% | 0.43% | 0.13% | 0.3% | 5% | 1 |
| Perennial Forb | 1.9% | 3.83% | 1.16% | 2.7% | 5% | 3 |
| Perennial Grass | 4.9% | 10.01% | 3.02% | 7.1% | 5% | 18 |
| Subshrub | 7.4% | 4.76% | 1.43% | 3.4% | 5% | 4 |
| Shrub | 6.9% | 4.92% | 1.48% | 3.5% | 5% | 5 |
| Succulent | 3.3% | 4.04% | 1.22% | 2.9% | 5% | 3 |
| Tree | 2.6% | 1.48% | 0.45% | 1.0% | 5% | 1 |
| Snag | 5.8% | 5.58% | 1.68% | 3.9% | 5% | 6 |
| Vine | 2.5% | 2.63% | 0.79% | 1.9% | 5% | 2 |
| Total | 33.1% | 13.87% | 4.18% | 9.8% | 6% | 23 |

Table A2a. Within-plot cover values (%) for species measured in the subcanopy layer of terrestrial vegetation and soils plots, 101 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| Species | Individual plot measures | | Across-plot measures | | | | | |
|------------------------------------|--------------------------|---------|----------------------|------|------|-------|-----|----|
| | 2009 | 2010 | AVG | STD | SE | Sdiff | MDC | n= |
| | 101_V01 | 101_V02 | | | | | | |
| Forb/Herb | | | | | | | | |
| <i>Artemisia ludoviciana</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Graminoid | | | | | | | | |
| <i>Bouteloua curtipendula</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Subshrub | | | | | | | | |
| <i>Abutilon incanum</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Ambrosia deltoidea</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Encelia farinosa</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Shrub | | | | | | | | |
| <i>Aloysia wrightii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Celtis ehrenbergiana</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Fouquieria splendens</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Jatropha cardiophylla</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Larrea tridentata</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Lycium andersonii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Lycium berlandieri</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Simmondsia chinensis</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Succulent | | | | | | | | |
| <i>Carnegiea gigantea</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Cylindropuntia acanthocarpa</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Cylindropuntia arbuscula</i> | 1.3% | 0.0% | 0.6% | 0.9% | 0.6% | 0.6% | 5% | 1 |
| <i>Cylindropuntia fulgida</i> | 0.0% | 0.4% | 0.2% | 0.3% | 0.2% | 0.2% | 5% | 1 |
| <i>Cylindropuntia leptocaulis</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Dasyliirion wheeleri</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Opuntia chlorotica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Opuntia engelmannii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Opuntia phaeacantha</i> | 0.0% | 0.8% | 0.4% | 0.6% | 0.4% | 0.4% | 5% | 1 |
| Tree | | | | | | | | |
| <i>Acacia constricta</i> | 1.7% | 0.4% | 1.0% | 0.9% | 0.6% | 0.6% | 5% | 1 |
| <i>Acacia greggii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Celtis laevigata</i> | 2.1% | 0.0% | 1.0% | 1.5% | 1.0% | 1.0% | 5% | 1 |
| <i>Olneya tesota</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Parkinsonia microphylla</i> | 2.5% | 0.0% | 1.3% | 1.8% | 1.3% | 1.3% | 5% | 1 |
| <i>Prosopis velutina</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Vauquelinia californica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Vine | | | | | | | | |
| <i>Janusia gracilis</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |

Table A2a. Within-plot cover values (%) for species measured in the subcanopy layer of terrestrial vegetation and soils plots, 101 stratum, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Species | Individual plot measures | | Across-plot measures | | | | | |
|---------------------------|--------------------------|---------|----------------------|------|------|-------|-----|----|
| | 2009 | 2010 | AVG | STD | SE | Sdiff | MDC | n= |
| | 101_V01 | 101_V02 | | | | | | |
| Totals by lifeform | | | | | | | | |
| Annual Forb | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Annual Grass | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Perennial Forb | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Perennial Grass | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Subshrub | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Shrub | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Succulent | 1.25% | 1.25% | 1.3% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Tree | 6.25% | 0.42% | 3.3% | 4.1% | 2.9% | 2.9% | 5% | 3 |
| Snag | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Vine | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Total | 7.50% | 1.67% | 4.6% | 4.1% | 2.9% | 2.9% | 5% | 3 |

Table A2b. Within-plot cover values (%) for species measured in the subcanopy layer of terrestrial vegetation and soils plots, 102 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| Species | Individual plot measures | | Across-plot measures | | | | | |
|------------------------------------|--------------------------|---------|----------------------|------|------|-------|-----|----|
| | 2009 | 2010 | AVG | STD | SE | Sdiff | MDC | n= |
| | 102_V01 | 102_V02 | | | | | | |
| Forb/Herb | | | | | | | | |
| <i>Artemisia ludoviciana</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Graminoid | | | | | | | | |
| <i>Bouteloua curtipendula</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Subshrub | | | | | | | | |
| <i>Abutilon incanum</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Ambrosia deltoidea</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Encelia farinosa</i> | 0.0% | 2.1% | 1.0% | 1.5% | 1.0% | 1.0% | 5% | 1 |
| Shrub | | | | | | | | |
| <i>Aloysia wrightii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Celtis ehrenbergiana</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Fouquieria splendens</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Jatropha cardiophylla</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Larrea tridentata</i> | 0.0% | 0.8% | 0.4% | 0.6% | 0.4% | 0.4% | 5% | 1 |
| <i>Lycium andersonii</i> | 0.8% | 0.0% | 0.4% | 0.6% | 0.4% | 0.4% | 5% | 1 |
| <i>Lycium berlandieri</i> | 0.0% | 2.1% | 1.0% | 1.5% | 1.0% | 1.0% | 5% | 1 |
| <i>Simmondsia chinensis</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Succulent | | | | | | | | |
| <i>Carnegiea gigantea</i> | 0.4% | 0.0% | 0.2% | 0.3% | 0.2% | 0.2% | 5% | 1 |
| <i>Cylindropuntia acanthocarpa</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Cylindropuntia arbuscula</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Cylindropuntia fulgida</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Cylindropuntia leptocaulis</i> | 0.4% | 0.0% | 0.2% | 0.3% | 0.2% | 0.2% | 5% | 1 |
| <i>Dasyliion wheeleri</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Opuntia chlorotica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Opuntia engelmannii</i> | 0.0% | 0.4% | 0.2% | 0.3% | 0.2% | 0.2% | 5% | 1 |
| <i>Opuntia phaeacantha</i> | 0.0% | 0.8% | 0.4% | 0.6% | 0.4% | 0.4% | 5% | 1 |
| Tree | | | | | | | | |
| <i>Acacia constricta</i> | 0.8% | 3.3% | 2.1% | 1.8% | 1.3% | 1.3% | 5% | 1 |
| <i>Acacia greggii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Celtis laevigata</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Olneya tesota</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Parkinsonia microphylla</i> | 8.8% | 11.7% | 10.2% | 2.1% | 1.5% | 1.5% | 5% | 1 |
| <i>Prosopis velutina</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Vauquelinia californica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Vine | | | | | | | | |
| <i>Janusia gracilis</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |

Table A2b. Within-plot cover values (%) for species measured in the subcanopy layer of terrestrial vegetation and soils plots, 102 stratum, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Species | Individual plot measures | | Across-plot measures | | | | | | |
|---------------------------|--------------------------|---------------|----------------------|-------------|-------------|-------------|-----------|----------|--|
| | 2009 | 2010 | AVG | STD | SE | Sdiff | MDC | n= | |
| | 102_V01 | 102_V02 | | | | | | | |
| Totals by lifeform | | | | | | | | | |
| Annual Forb | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 | |
| Annual Grass | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 | |
| Perennial Forb | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 | |
| Perennial Grass | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 | |
| Subshrub | 0.00% | 2.08% | 1.0% | 1.5% | 1.0% | 1.0% | 5% | 1 | |
| Shrub | 0.83% | 2.92% | 1.9% | 1.5% | 1.0% | 1.0% | 5% | 1 | |
| Succulent | 0.83% | 1.25% | 1.0% | 0.3% | 0.2% | 0.2% | 5% | 1 | |
| Tree | 9.58% | 15.00% | 12.3% | 3.8% | 2.7% | 2.7% | 5% | 3 | |
| Snag | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 | |
| Vine | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 | |
| Total | 11.25% | 21.25% | 16.3% | 7.1% | 5.0% | 5.0% | 7% | 5 | |

Table A2c. Within-plot cover values (%) for species measured in the subcanopy layer of terrestrial vegetation and soils plots, 202 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| Species | Individual plot measures | | | | | | Across-plot measures | | | | | |
|------------------------------------|--------------------------|---------|---------|---------|---------|---------|----------------------|------|------|-------|-----|----|
| | 2009 | | | 2010 | | | AVG | STD | SE | Sdiff | MDC | n= |
| | 202_V01 | 202_V02 | 202_V03 | 202_V04 | 202_V05 | 202_V06 | | | | | | |
| Forb/Herb | | | | | | | | | | | | |
| <i>Artemisia ludoviciana</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Graminoid | | | | | | | | | | | | |
| <i>Bouteloua curtipendula</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Subshrub | | | | | | | | | | | | |
| <i>Abutilon incanum</i> | 0.8% | 2.1% | 1.7% | 0.0% | 0.0% | 0.0% | 0.8% | 0.9% | 0.4% | 0.7% | 5% | 1 |
| <i>Ambrosia deltoidea</i> | 0.4% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | 0.2% | 0.1% | 0.1% | 5% | 1 |
| <i>Encelia farinosa</i> | 1.7% | 0.0% | 0.4% | 0.0% | 0.0% | 0.4% | 0.4% | 0.6% | 0.3% | 0.5% | 5% | 1 |
| Shrub | | | | | | | | | | | | |
| <i>Aloysia wrightii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Celtis ehrenbergiana</i> | 0.0% | 0.0% | 0.0% | 0.0% | 1.3% | 0.0% | 0.2% | 0.5% | 0.2% | 0.4% | 5% | 1 |
| <i>Fouquieria splendens</i> | 1.3% | 0.0% | 0.4% | 0.0% | 0.0% | 0.8% | 0.4% | 0.5% | 0.2% | 0.4% | 5% | 1 |
| <i>Jatropha cardiophylla</i> | 0.4% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | 0.2% | 0.1% | 0.1% | 5% | 1 |
| <i>Larrea tridentata</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Lycium andersonii</i> | 0.4% | 0.4% | 1.3% | 0.0% | 0.0% | 0.0% | 0.3% | 0.5% | 0.2% | 0.3% | 5% | 1 |
| <i>Lycium berlandieri</i> | 0.0% | 0.0% | 0.0% | 2.9% | 2.1% | 5.0% | 1.7% | 2.1% | 0.8% | 1.5% | 5% | 1 |
| <i>Simmondsia chinensis</i> | 0.0% | 1.3% | 6.3% | 6.7% | 0.0% | 0.0% | 2.4% | 3.2% | 1.3% | 2.3% | 5% | 2 |
| Succulent | | | | | | | | | | | | |
| <i>Carnegiea gigantea</i> | 0.4% | 0.0% | 0.0% | 0.0% | 0.0% | 0.4% | 0.1% | 0.2% | 0.1% | 0.2% | 5% | 1 |
| <i>Cylindropuntia acanthocarpa</i> | 0.0% | 0.0% | 0.0% | 0.4% | 2.5% | 0.4% | 0.6% | 1.0% | 0.4% | 0.7% | 5% | 1 |
| <i>Cylindropuntia arbuscula</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Cylindropuntia fulgida</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Cylindropuntia leptocaulis</i> | 0.0% | 0.0% | 1.7% | 0.0% | 0.0% | 0.0% | 0.3% | 0.7% | 0.3% | 0.5% | 5% | 1 |
| <i>Dasyliiron wheeleri</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Opuntia chlorotica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Opuntia engelmannii</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.8% | 0.0% | 0.1% | 0.3% | 0.1% | 0.2% | 5% | 1 |
| <i>Opuntia phaeacantha</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |

Table A2c. Within-plot cover values (%) for species measured in the subcanopy layer of terrestrial vegetation and soils plots, 202 stratum, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Species | Individual plot measures | | | | | Across-plot measures | | | | | |
|--------------------------------|--------------------------|--------------|---------------|---------------|---------------|----------------------|-------------|-------------|-------------|-----------|-----------|
| | 2009 | | 2010 | | | AVG | STD | SE | Sdiff | MDC | n= |
| | 202_V01 | 202_V02 | 202_V03 | 202_V04 | 202_V05 | | | | | | |
| Tree | | | | | | | | | | | |
| <i>Acacia constricta</i> | 2.9% | 0.8% | 5.4% | 1.7% | 3.3% | 0.0% | 1.9% | 0.8% | 1.4% | 5% | 1 |
| <i>Acacia greggii</i> | 0.0% | 0.4% | 0.0% | 0.0% | 0.0% | 0.0% | 0.2% | 0.1% | 0.1% | 5% | 1 |
| <i>Celtis laevigata</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Olneya tesota</i> | 0.4% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.2% | 0.1% | 0.1% | 5% | 1 |
| <i>Parkinsonia microphylla</i> | 4.2% | 0.0% | 8.3% | 0.8% | 9.6% | 11.3% | 4.7% | 1.9% | 3.3% | 5% | 4 |
| <i>Prosopis velutina</i> | 0.0% | 0.0% | 2.5% | 0.0% | 0.0% | 0.4% | 1.0% | 0.4% | 0.7% | 5% | 1 |
| <i>Vauquelinia californica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Vine | | | | | | | | | | | |
| <i>Janusia gracilis</i> | 0.4% | 2.5% | 1.7% | 0.8% | 2.1% | 0.0% | 1.0% | 0.4% | 0.7% | 5% | 1 |
| Totals by lifeform | | | | | | | | | | | |
| Annual Forb | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Annual Grass | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Perennial Forb | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Perennial Grass | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Subshrub | 2.92% | 2.08% | 2.08% | 0.00% | 0.00% | 0.42% | 1.3% | 0.5% | 0.9% | 5% | 1 |
| Shrub | 2.08% | 1.67% | 7.92% | 9.58% | 3.33% | 5.83% | 3.2% | 1.3% | 2.3% | 5% | 2 |
| Succulent | 0.42% | 0.00% | 1.67% | 0.42% | 3.33% | 0.83% | 1.2% | 0.5% | 0.9% | 5% | 1 |
| Tree | 7.92% | 3.75% | 17.92% | 3.33% | 15.00% | 11.67% | 6.0% | 2.4% | 4.2% | 5% | 7 |
| Snag | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Vine | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Total | 13.33% | 7.50% | 29.58% | 13.33% | 21.67% | 18.75% | 7.7% | 3.2% | 5.5% | 5% | 11 |

Table A2d. Within-plot cover values (%) for species measured in the subcanopy layer of terrestrial vegetation and soils plots, 302 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| Species | 2009 | Across-plot measures | | | | | |
|------------------------------------|---------|----------------------|-----|-----|-------|-----|-----|
| | 302_V02 | AVG | STD | SE | Sdiff | MDC | n= |
| Forb/Herb | | | | | | | |
| <i>Artemisia ludoviciana</i> | 0.8% | n/a | n/a | n/a | n/a | 5% | n/a |
| Graminoid | | | | | | | |
| <i>Bouteloua curtipendula</i> | 2.5% | n/a | n/a | n/a | n/a | 5% | n/a |
| Subshrub | | | | | | | |
| <i>Abutilon incanum</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Ambrosia deltoidea</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Encelia farinosa</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| Shrub | | | | | | | |
| <i>Aloysia wrightii</i> | 0.4% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Celtis ehrenbergiana</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Fouquieria splendens</i> | 0.4% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Jatropha cardiophylla</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Larrea tridentata</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Lycium andersonii</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Lycium berlandieri</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Simmondsia chinensis</i> | 2.9% | n/a | n/a | n/a | n/a | 5% | n/a |
| Succulent | | | | | | | |
| <i>Carnegiea gigantea</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Cylindropuntia acanthocarpa</i> | 0.4% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Cylindropuntia arbuscula</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Cylindropuntia fulgida</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Cylindropuntia leptocaulis</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Dasyliion wheeleri</i> | 1.7% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Opuntia chlorotica</i> | 0.4% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Opuntia engelmannii</i> | 0.4% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Opuntia phaeacantha</i> | 0.8% | n/a | n/a | n/a | n/a | 5% | n/a |
| Tree | | | | | | | |
| <i>Acacia constricta</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Acacia greggii</i> | 4.2% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Celtis laevigata</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Olneya tesota</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Parkinsonia microphylla</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Prosopis velutina</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Vauquelinia californica</i> | 1.7% | n/a | n/a | n/a | n/a | 5% | n/a |
| Vine | | | | | | | |
| <i>Janusia gracilis</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |

Table A2d. Within-plot cover values (%) for species measured in the subcanopy layer of terrestrial vegetation and soils plots, 302 stratum, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Species | 2009 | Across-plot measures | | | | | |
|---------------------------|---------|----------------------|-----|-----|-------|-----|-----|
| | 302_V02 | AVG | STD | SE | Sdiff | MDC | n= |
| Totals by lifeform | | | | | | | |
| Annual Forb | 0.00% | n/a | n/a | n/a | n/a | 5% | n/a |
| Annual Grass | 0.00% | n/a | n/a | n/a | n/a | 5% | n/a |
| Perennial Forb | 0.83% | n/a | n/a | n/a | n/a | 5% | n/a |
| Perennial Grass | 2.50% | n/a | n/a | n/a | n/a | 5% | n/a |
| Subshrub | 0.00% | n/a | n/a | n/a | n/a | 5% | n/a |
| Shrub | 3.75% | n/a | n/a | n/a | n/a | 5% | n/a |
| Succulent | 3.75% | n/a | n/a | n/a | n/a | 5% | n/a |
| Tree | 5.83% | n/a | n/a | n/a | n/a | 5% | n/a |
| Snag | 0.00% | n/a | n/a | n/a | n/a | 5% | n/a |
| Vine | 0.00% | n/a | n/a | n/a | n/a | 5% | n/a |
| Total | 16.67% | n/a | n/a | n/a | n/a | 5% | n/a |

Table A2e. Within-plot cover values (%) for species measured in the subcanopy layer of terrestrial vegetation and soils plots, all strata, Tucson Mountain District, Saguaro NP, 2009–2010.

| Species | AVG | STD | SE | Sdiff | MDC | n= |
|------------------------------------|------|-------|-------|-------|-----|----|
| Forb/Herb | | | | | | |
| <i>Artemisia ludoviciana</i> | 0.1% | 0.25% | 0.08% | 0.2% | 5% | 1 |
| Graminoid | | | | | | |
| <i>Bouteloua curtipendula</i> | 0.2% | 0.75% | 0.23% | 0.5% | 5% | 1 |
| Subshrub | | | | | | |
| <i>Abutilon incanum</i> | 0.4% | 0.77% | 0.23% | 0.5% | 5% | 1 |
| <i>Ambrosia deltoidea</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| <i>Encelia farinosa</i> | 0.4% | 0.75% | 0.22% | 0.5% | 5% | 1 |
| Shrub | | | | | | |
| <i>Aloysia wrightii</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| <i>Celtis ehrenbergiana</i> | 0.1% | 0.38% | 0.11% | 0.3% | 5% | 1 |
| <i>Fouquieria splendens</i> | 0.3% | 0.43% | 0.13% | 0.3% | 5% | 1 |
| <i>Jatropha cardiophylla</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| <i>Larrea tridentata</i> | 0.1% | 0.25% | 0.08% | 0.2% | 5% | 1 |
| <i>Lycium andersonii</i> | 0.3% | 0.43% | 0.13% | 0.3% | 5% | 1 |
| <i>Lycium berlandieri</i> | 1.1% | 1.70% | 0.51% | 1.2% | 5% | 1 |
| <i>Simmondsia chinensis</i> | 1.6% | 2.59% | 0.78% | 1.8% | 5% | 2 |
| Succulent | | | | | | |
| <i>Carnegiea gigantea</i> | 0.1% | 0.19% | 0.06% | 0.1% | 5% | 1 |
| <i>Cylindropuntia acanthocarpa</i> | 0.3% | 0.74% | 0.22% | 0.5% | 5% | 1 |
| <i>Cylindropuntia arbuscula</i> | 0.1% | 0.38% | 0.11% | 0.3% | 5% | 1 |
| <i>Cylindropuntia fulgida</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| <i>Cylindropuntia leptocaulis</i> | 0.2% | 0.51% | 0.15% | 0.4% | 5% | 1 |
| <i>Dasyliirion wheeleri</i> | 0.2% | 0.50% | 0.15% | 0.4% | 5% | 1 |
| <i>Opuntia chlorotica</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| <i>Opuntia engelmannii</i> | 0.2% | 0.28% | 0.08% | 0.2% | 5% | 1 |
| <i>Opuntia phaeacantha</i> | 0.2% | 0.39% | 0.12% | 0.3% | 5% | 1 |
| Tree | | | | | | |
| <i>Acacia constricta</i> | 1.9% | 1.71% | 0.52% | 1.2% | 5% | 1 |
| <i>Acacia greggii</i> | 0.4% | 1.25% | 0.38% | 0.9% | 5% | 1 |
| <i>Celtis laevigata</i> | 0.2% | 0.63% | 0.19% | 0.4% | 5% | 1 |
| <i>Olneya tesota</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| <i>Parkinsonia microphylla</i> | 5.2% | 4.78% | 1.44% | 3.4% | 5% | 4 |
| <i>Prosopis velutina</i> | 0.3% | 0.75% | 0.23% | 0.5% | 5% | 1 |
| <i>Vauquelinia californica</i> | 0.2% | 0.50% | 0.15% | 0.4% | 5% | 1 |
| Vine | | | | | | |
| <i>Janusia gracilis</i> | 0.7% | 0.96% | 0.29% | 0.7% | 5% | 1 |

Table A2e. Within-plot cover values (%) for species measured in the subcanopy layer of terrestrial vegetation and soils plots, all strata, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Species | AVG | STD | SE | Sdiff | MDC | n= |
|---------------------------|--------------|--------------|--------------|-------------|-----------|-----------|
| Totals by lifeform | | | | | | |
| Annual Forb | 0.0% | 0.00% | 0.00% | 0.0% | 5% | 0 |
| Annual Grass | 0.0% | 0.00% | 0.00% | 0.0% | 5% | 0 |
| Perennial Forb | 0.1% | 0.25% | 0.08% | 0.2% | 5% | 1 |
| Perennial Grass | 0.2% | 0.75% | 0.23% | 0.5% | 5% | 1 |
| Subshrub | 0.9% | 1.16% | 0.35% | 0.8% | 5% | 1 |
| Shrub | 3.4% | 3.15% | 0.95% | 2.2% | 5% | 2 |
| Succulent | 1.4% | 1.18% | 0.36% | 0.8% | 5% | 1 |
| Tree | 8.8% | 5.57% | 1.68% | 3.9% | 5% | 6 |
| Snag | 0.0% | 0.00% | 0.00% | 0.0% | 5% | 0 |
| Vine | 0.0% | 0.00% | 0.00% | 0.0% | 5% | 0 |
| Total | 14.8% | 7.89% | 2.38% | 5.6% | 5% | 11 |

Table A3a. Within-plot cover values (%) for species measured in the canopy layer of terrestrial vegetation and soils plots, 101 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| Species | Individual plot measures | | Across-plot measures | | | | | |
|--------------------------------|--------------------------|--------------|----------------------|-------------|-------------|-------------|-----------|----------|
| | 2009 | 2010 | AVG | STD | SE | Sdiff | MDC | n= |
| | 101_V01 | 101_V02 | | | | | | |
| Forb/Herb | | | | | | | | |
| <i>Packera neomexicana</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Succulent | | | | | | | | |
| <i>Fouquieria splendens</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Carnegieia gigantea</i> | 0.4% | 0.0% | 0.2% | 0.3% | 0.2% | 0.2% | 5% | 1 |
| Tree | | | | | | | | |
| <i>Acacia constricta</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Olneya tesota</i> | 1.7% | 0.0% | 0.8% | 1.2% | 0.8% | 0.8% | 5% | 1 |
| <i>Parkinsonia microphylla</i> | 0.8% | 0.0% | 0.4% | 0.6% | 0.4% | 0.4% | 5% | 1 |
| <i>Prosopis velutina</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Vauquelinia californica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Totals by lifeform | | | | | | | | |
| Annual Forb | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Annual Grass | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Perennial Forb | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Perennial Grass | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Subshrub | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Shrub | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Succulent | 0.42% | 0.00% | 0.2% | 0.3% | 0.2% | 0.2% | 5% | 1 |
| Tree | 2.50% | 0.00% | 1.3% | 1.8% | 1.3% | 1.3% | 5% | 1 |
| Snag | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Vine | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Total | 2.92% | 0.00% | 1.5% | 2.1% | 1.5% | 1.5% | 5% | 1 |

Table A3b. Within-plot cover values (%) for species measured in the canopy layer of terrestrial vegetation and soils plots, 102 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| Species | Individual plot measures | | Across-plot measures | | | | | |
|--------------------------------|--------------------------|--------------|----------------------|-------------|-------------|-------------|-----------|----------|
| | 2009 | 2010 | AVG | STD | SE | Sdiff | MDC | n= |
| | 102_V01 | 102_V02 | | | | | | |
| Forb/Herb | | | | | | | | |
| <i>Packera neomexicana</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Succulent | | | | | | | | |
| <i>Fouquieria splendens</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Carnegiea gigantea</i> | 0.4% | 0.0% | 0.2% | 0.3% | 0.2% | 0.2% | 5% | 1 |
| Tree | | | | | | | | |
| <i>Acacia constricta</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Olneya tesota</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Parkinsonia microphylla</i> | 1.7% | 5.8% | 3.8% | 2.9% | 2.1% | 2.1% | 5% | 2 |
| <i>Prosopis velutina</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| <i>Vauquelinia californica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Totals by lifeform | | | | | | | | |
| Annual Forb | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Annual Grass | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Perennial Forb | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Perennial Grass | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Subshrub | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Shrub | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Succulent | 0.42% | 0.00% | 0.2% | 0.3% | 0.2% | 0.2% | 5% | 1 |
| Tree | 1.67% | 5.83% | 3.8% | 2.9% | 2.1% | 2.1% | 5% | 2 |
| Snag | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Vine | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Total | 2.08% | 5.83% | 4.0% | 2.7% | 1.9% | 1.9% | 5% | 2 |

Table A3c. Within-plot cover values (%) for species measured in the canopy layer of terrestrial vegetation and soils plots, 202 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| Species | Individual plot measures | | | | | Across-plot measures | | | | | |
|--------------------------------|--------------------------|---------|---------|---------|---------|----------------------|------|------|-------|-----|----|
| | 2009 | | 2010 | | | AVG | STD | SE | Sdiff | MDC | n= |
| | 202_V01 | 202_V02 | 202_V03 | 202_V04 | 202_V05 | | | | | | |
| Forb/Herb | | | | | | | | | | | |
| <i>Packera neomexicana</i> | 0.0% | 0.0% | 0.4% | 0.0% | 0.0% | 0.1% | 0.2% | 0.1% | 0.1% | 5% | 1 |
| Succulent | | | | | | | | | | | |
| <i>Fouquieria splendens</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.2% | 0.5% | 0.2% | 0.4% | 5% | 1 |
| <i>Carnegiea gigantea</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | 0.2% | 0.1% | 0.1% | 5% | 1 |
| Tree | | | | | | | | | | | |
| <i>Acacia constricta</i> | 0.0% | 0.0% | 0.4% | 0.0% | 0.4% | 0.1% | 0.2% | 0.1% | 0.2% | 5% | 1 |
| <i>Olneya tesota</i> | 0.8% | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | 0.3% | 0.1% | 0.2% | 5% | 1 |
| <i>Parkinsonia microphylla</i> | 0.4% | 0.0% | 2.9% | 0.0% | 6.7% | 3.3% | 4.2% | 1.7% | 2.9% | 5% | 3 |
| <i>Prosopis velutina</i> | 0.0% | 0.0% | 0.4% | 0.0% | 0.0% | 0.1% | 0.2% | 0.1% | 0.1% | 5% | 1 |
| <i>Vauquelinia californica</i> | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Totals by lifeform | | | | | | | | | | | |
| Annual Forb | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Annual Grass | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Perennial Forb | 0.00% | 0.00% | 0.42% | 0.00% | 0.00% | 0.1% | 0.2% | 0.1% | 0.1% | 5% | 1 |
| Perennial Grass | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Subshrub | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Shrub | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Succulent | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.3% | 0.7% | 0.3% | 0.5% | 5% | 1 |
| Tree | 1.25% | 0.00% | 3.75% | 0.00% | 7.08% | 3.7% | 4.1% | 1.7% | 2.9% | 5% | 3 |
| Snag | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Vine | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Total | 1.25% | 0.00% | 4.17% | 0.00% | 7.08% | 4.0% | 4.6% | 1.9% | 3.3% | 5% | 4 |

Table A3d. Within-plot cover values (%) for species measured in the canopy layer of terrestrial vegetation and soils plots, 302 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| Species | 2009 | Across-plot measures | | | | | |
|--------------------------------|---------|----------------------|-----|-----|-------|-----|-----|
| | 302_V02 | AVG | STD | SE | Sdiff | MDC | n= |
| Forb/Herb | | | | | | | |
| <i>Packera neomexicana</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| Succulent | | | | | | | |
| <i>Fouquieria splendens</i> | 0.4% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Carnegiea gigantea</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| Tree | | | | | | | |
| <i>Acacia constricta</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Olneya tesota</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Parkinsonia microphylla</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Prosopis velutina</i> | 0.0% | n/a | n/a | n/a | n/a | 5% | n/a |
| <i>Vauquelinia californica</i> | 0.8% | n/a | n/a | n/a | n/a | 5% | n/a |
| Totals by lifeform | | | | | | | |
| Annual Forb | 0.00% | n/a | n/a | n/a | n/a | 5% | n/a |
| Annual Grass | 0.00% | n/a | n/a | n/a | n/a | 5% | n/a |
| Perennial Forb | 0.00% | n/a | n/a | n/a | n/a | 5% | n/a |
| Perennial Grass | 0.00% | n/a | n/a | n/a | n/a | 5% | n/a |
| Subshrub | 0.00% | n/a | n/a | n/a | n/a | 5% | n/a |
| Shrub | 0.00% | n/a | n/a | n/a | n/a | 5% | n/a |
| Succulent | 0.42% | n/a | n/a | n/a | n/a | 5% | n/a |
| Tree | 0.83% | n/a | n/a | n/a | n/a | 5% | n/a |
| Snag | 0.00% | n/a | n/a | n/a | n/a | 5% | n/a |
| Vine | 0.00% | n/a | n/a | n/a | n/a | 5% | n/a |
| Total | 1.25% | n/a | n/a | n/a | n/a | 5% | n/a |

Table A3e. Within-plot cover values (%) for species measured in the canopy layer of terrestrial vegetation and soils plots, all strata, Tucson Mountain District, Saguaro NP, 2009–2010.

| Species | AVG | STD | SE | Sdiff | MDC | n= |
|--------------------------------|-------------|--------------|--------------|-------------|-----------|----------|
| Forb/Herb | | | | | | |
| <i>Packera neomexicana</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| Succulent | | | | | | |
| <i>Fouquieria splendens</i> | 0.2% | 0.39% | 0.12% | 0.3% | 5% | 1 |
| <i>Carnegiea gigantea</i> | 0.1% | 0.19% | 0.06% | 0.1% | 5% | 1 |
| Tree | | | | | | |
| <i>Acacia constricta</i> | 0.1% | 0.17% | 0.05% | 0.1% | 5% | 1 |
| <i>Olneya tesota</i> | 0.2% | 0.54% | 0.16% | 0.4% | 5% | 1 |
| <i>Parkinsonia microphylla</i> | 2.6% | 3.43% | 1.03% | 2.4% | 5% | 3 |
| <i>Prosopis velutina</i> | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| <i>Vauquelinia californica</i> | 0.1% | 0.25% | 0.08% | 0.2% | 5% | 1 |
| Totals by lifeform | | | | | | |
| Annual Forb | 0.0% | 0.00% | 0.00% | 0.0% | 5% | 0 |
| Annual Grass | 0.0% | 0.00% | 0.00% | 0.0% | 5% | 0 |
| Perennial Forb | 0.0% | 0.13% | 0.04% | 0.1% | 5% | 1 |
| Perennial Grass | 0.0% | 0.00% | 0.00% | 0.0% | 5% | 0 |
| Subshrub | 0.0% | 0.00% | 0.00% | 0.0% | 5% | 0 |
| Shrub | 0.0% | 0.00% | 0.00% | 0.0% | 5% | 0 |
| Succulent | 0.3% | 0.50% | 0.15% | 0.4% | 5% | 1 |
| Tree | 3.0% | 3.33% | 1.00% | 2.4% | 5% | 2 |
| Snag | 0.0% | 0.00% | 0.00% | 0.0% | 5% | 0 |
| Vine | 0.0% | 0.00% | 0.00% | 0.0% | 5% | 0 |
| Total | 3.3% | 3.66% | 1.10% | 2.6% | 5% | 3 |

Table A4a. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, 101 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| Scientific name | Nativity | Within-plot frequency (0–5) | | Within-plot frequency (%) | | | |
|------------------------------------|----------|-----------------------------|---------|---------------------------|-------|---------|---------------------|
| | | 101_V01 | 101_V02 | Mean | SE | # sites | Landscape frequency |
| Forb/Herb | | | | | | | |
| <i>Acourtia wrightii</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Argythamnia neomexicana</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Artemisia ludoviciana</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Carlowrightia arizonica</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Chamaesyce</i> | N/A | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Cheilanthes lindheimeri</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| ANNUAL FORB | N/A | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Packera neomexicana</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Pellaea truncata</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Selaginella arizonica</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Tragia ramosa</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| Graminoid | | | | | | | |
| <i>Aristida purpurea</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Aristida ternipes</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Bouteloua curtipendula</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Bouteloua repens</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Digitaria californica</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Echinochloa</i> sp. | N/A | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Heteropogon contortus</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Hilaria belangeri</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Hilaria mutica</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Leptochloa dubia</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Muhlenbergia porteri</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| ANNUAL GRASS | N/A | 0 | 2 | 20% | 20.0% | 1 | 50% |
| <i>Tridens muticus</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| Subshrub | | | | | | | |
| <i>Abutilon incanum</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Acacia angustissima</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Adenophyllum porophylloides</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Ambrosia deltoidea</i> | Native | 5 | 5 | 100% | 0.0% | 2 | 100% |
| <i>Argythamnia lanceolata</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Ayenia filiformis</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Baccharis brachyphylla</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Brickellia coulteri</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Encelia farinosa</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Ericameria laricifolia</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Eriogonum wrightii</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Herissantia crispa</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |

Table A4a. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, 101 stratum, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Scientific name | Nativity | Within-plot frequency (0–5) | | Within-plot frequency (%) | | | |
|--------------------------------------|----------|-----------------------------|---------|---------------------------|-------|---------|---------------------|
| | | 101_V01 | 101_V02 | Mean | SE | # sites | Landscape frequency |
| Subshrub, cont. | | | | | | | |
| <i>Hibiscus coulteri</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Hibiscus denudatus</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Koanophyllon solidaginifolium</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Krameria grayi</i> | Native | 0 | 4 | 40% | 40.0% | 1 | 50% |
| <i>Menodora scabra</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Phoradendron californicum</i> | Native | 1 | 0 | 10% | 10.0% | 1 | 50% |
| <i>Porophyllum gracile</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Sphaeralcea</i> | N/A | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Stephanomeria pauciflora</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Trixis californica</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Zinnia acerosa</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| Shrub | | | | | | | |
| <i>Aloysia wrightii</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Atriplex canescens</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Calliandra eriophylla</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Celtis ehrenbergiana</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Crossosoma bigelovii</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Ephedra trifurca</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Fouquieria splendens</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Hyptis emoryi</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Jatropha cardiophylla</i> | Native | 0 | 3 | 30% | 30.0% | 1 | 50% |
| <i>Larrea tridentata</i> | Native | 2 | 4 | 60% | 20.0% | 2 | 100% |
| <i>Lycium</i> | N/A | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Lycium andersonii</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Lycium berlandieri</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Lycium fremontii</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Matelea parvifolia</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| SNAG | N/A | 2 | 5 | 70% | 30.0% | 2 | 100% |
| <i>Simmondsia chinensis</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Ziziphus obtusifolia</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |

Table A4a. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, 101 stratum, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Scientific name | Nativity | Within-plot frequency (0–5) | | Within-plot frequency (%) | | | |
|------------------------------------|----------|-----------------------------|---------|---------------------------|-------|---------|---------------------|
| | | 101_V01 | 101_V02 | Mean | SE | # sites | Landscape frequency |
| Succulent | | | | | | | |
| <i>Agave schottii</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Carnegiea gigantea</i> | Native | 5 | 3 | 80% | 20.0% | 2 | 100% |
| <i>Cylindropuntia acanthocarpa</i> | Native | 4 | 4 | 80% | 0.0% | 2 | 100% |
| <i>Cylindropuntia arbuscula</i> | Native | 4 | 1 | 50% | 30.0% | 2 | 100% |
| <i>Cylindropuntia bigelovii</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Cylindropuntia fulgida</i> | Native | 0 | 1 | 10% | 10.0% | 1 | 50% |
| <i>Cylindropuntia leptocaulis</i> | Native | 1 | 0 | 10% | 10.0% | 1 | 50% |
| <i>Dasyliirion wheeleri</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Echinocereus engelmannii</i> | Native | 0 | 1 | 10% | 10.0% | 1 | 50% |
| <i>Ferocactus wislizeni</i> | Native | 2 | 3 | 50% | 10.0% | 2 | 100% |
| <i>Mammillaria</i> | N/A | 2 | 0 | 20% | 20.0% | 1 | 50% |
| <i>Mammillaria grahamii</i> | Native | 0 | 4 | 40% | 40.0% | 1 | 50% |
| <i>Opuntia chlorotica</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Opuntia engelmannii</i> | Native | 5 | 1 | 60% | 40.0% | 2 | 100% |
| <i>Opuntia phaeacantha</i> | Native | 0 | 4 | 40% | 40.0% | 1 | 50% |
| Tree | | | | | | | |
| <i>Acacia constricta</i> | Native | 2 | 3 | 50% | 10.0% | 2 | 100% |
| <i>Acacia greggii</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Celtis laevigata</i> | Native | 1 | 0 | 10% | 10.0% | 1 | 50% |
| <i>Olneya tesota</i> | Native | 4 | 0 | 40% | 40.0% | 1 | 50% |
| <i>Parkinsonia microphylla</i> | Native | 3 | 2 | 50% | 10.0% | 2 | 100% |
| <i>Prosopis velutina</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Vauquelinia californica</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| Vine | | | | | | | |
| <i>Boerhavia scandens</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Janusia gracilis</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| N/A | | | | | | | |
| <i>Astrolepis</i> sp. | N/A | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Cirsium</i> sp. | N/A | 0 | 0 | 0% | 0.0% | 0 | 0% |

Species that are highlighted fail to meet our statistical power criteria.

Table A4b. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, 102 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| Scientific name | Nativity | Within-plot frequency (0–5) | | Within-plot frequency (%) | | | |
|------------------------------------|----------|-----------------------------|---------|---------------------------|-------|---------|---------------------|
| | | 102_V01 | 102_V02 | Mean | SE | # sites | Landscape frequency |
| Forb/Herb | | | | | | | |
| <i>Acourtia wrightii</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Argythamnia neomexicana</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Artemisia ludoviciana</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Carlowrightia arizonica</i> | Native | 0 | 1 | 10% | 10.0% | 1 | 50% |
| <i>Chamaesyce</i> | N/A | 0 | 3 | 30% | 30.0% | 1 | 50% |
| <i>Cheilanthes lindheimeri</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| ANNUAL FORB | N/A | 0 | 5 | 50% | 50.0% | 1 | 50% |
| <i>Packera neomexicana</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Pellaea truncata</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Selaginella arizonica</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Tragia ramosa</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| Graminoid | | | | | | | |
| <i>Aristida purpurea</i> | Native | 1 | 0 | 10% | 10.0% | 1 | 50% |
| <i>Aristida ternipes</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Bouteloua curtipendula</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Bouteloua repens</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Digitaria californica</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Echinochloa</i> sp. | N/A | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Heteropogon contortus</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Hilaria belangeri</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Hilaria mutica</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Leptochloa dubia</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Muhlenbergia porteri</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| ANNUAL GRASS | N/A | 0 | 1 | 10% | 10.0% | 1 | 50% |
| <i>Tridens muticus</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| Subshrub | | | | | | | |
| <i>Abutilon incanum</i> | Native | 3 | 1 | 40% | 20.0% | 2 | 100% |
| <i>Acacia angustissima</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Adenophyllum porophylloides</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Ambrosia deltoidea</i> | Native | 5 | 2 | 70% | 30.0% | 2 | 100% |
| <i>Argythamnia lanceolata</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Ayenia filiformis</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Baccharis brachyphylla</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Brickellia coulteri</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Encelia farinosa</i> | Native | 5 | 5 | 100% | 0.0% | 2 | 100% |
| <i>Ericameria laricifolia</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Eriogonum wrightii</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Herissantia crispa</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Hibiscus coulteri</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |

Table A4b. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, 102 stratum, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Scientific name | Nativity | Within-plot frequency (0–5) | | Within-plot frequency (%) | | | |
|--------------------------------------|----------|-----------------------------|---------|---------------------------|-------|---------|---------------------|
| | | 102_V01 | 102_V02 | Mean | SE | # sites | Landscape frequency |
| Subshrub, cont. | | | | | | | |
| <i>Hibiscus denudatus</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Koanophyllon solidaginifolium</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Krameria grayi</i> | Native | 0 | 5 | 50% | 50.0% | 1 | 50% |
| <i>Menodora scabra</i> | Native | 4 | 4 | 80% | 0.0% | 2 | 100% |
| <i>Phoradendron californicum</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Porophyllum gracile</i> | Native | 0 | 2 | 20% | 20.0% | 1 | 50% |
| <i>Sphaeralcea</i> | N/A | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Stephanomeria pauciflora</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Trixis californica</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Zinnia acerosa</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| Shrub | | | | | | | |
| <i>Aloysia wrightii</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Atriplex canescens</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Calliandra eriophylla</i> | Native | 1 | 5 | 60% | 40.0% | 2 | 100% |
| <i>Celtis ehrenbergiana</i> | Native | 0 | 1 | 10% | 10.0% | 1 | 50% |
| <i>Crossosoma bigelovii</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Ephedra trifurca</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Fouquieria splendens</i> | Native | 1 | 1 | 20% | 0.0% | 2 | 100% |
| <i>Hyptis emoryi</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Jatropha cardiophylla</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Larrea tridentata</i> | Native | 0 | 2 | 20% | 20.0% | 1 | 50% |
| <i>Lycium</i> | N/A | 2 | 0 | 20% | 20.0% | 1 | 50% |
| <i>Lycium andersonii</i> | Native | 3 | 0 | 30% | 30.0% | 1 | 50% |
| <i>Lycium berlandieri</i> | Native | 0 | 5 | 50% | 50.0% | 1 | 50% |
| <i>Lycium fremontii</i> | Native | 0 | 2 | 20% | 20.0% | 1 | 50% |
| <i>Matelea parvifolia</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| SNAG | N/A | 5 | 4 | 90% | 10.0% | 2 | 100% |
| <i>Simmondsia chinensis</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Ziziphus obtusifolia</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| Succulent | | | | | | | |
| <i>Agave schottii</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Carnegiea gigantea</i> | Native | 5 | 3 | 80% | 20.0% | 2 | 100% |
| <i>Cylindropuntia acanthocarpa</i> | Native | 0 | 5 | 50% | 50.0% | 1 | 50% |
| <i>Cylindropuntia arbuscula</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Cylindropuntia bigelovii</i> | Native | 4 | 0 | 40% | 40.0% | 1 | 50% |
| <i>Cylindropuntia fulgida</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Cylindropuntia leptocaulis</i> | Native | 5 | 3 | 80% | 20.0% | 2 | 100% |
| <i>Dasyliirion wheeleri</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Echinocereus engelmannii</i> | Native | 0 | 2 | 20% | 20.0% | 1 | 50% |

Table A4b. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, 102 stratum, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Scientific name | Nativity | Within-plot frequency (0–5) | | Within-plot frequency (%) | | | |
|--------------------------------|----------|-----------------------------|---------|---------------------------|-------|---------|---------------------|
| | | 102_V01 | 102_V02 | Mean | SE | # sites | Landscape frequency |
| Succulent, cont. | | | | | | | |
| <i>Ferocactus wislizeni</i> | Native | 4 | 3 | 70% | 10.0% | 2 | 100% |
| <i>Mammillaria</i> | N/A | 1 | 0 | 10% | 10.0% | 1 | 50% |
| <i>Mammillaria grahamii</i> | Native | 0 | 2 | 20% | 20.0% | 1 | 50% |
| <i>Opuntia chlorotica</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Opuntia engelmannii</i> | Native | 1 | 2 | 30% | 10.0% | 2 | 100% |
| <i>Opuntia phaeacantha</i> | Native | 0 | 5 | 50% | 50.0% | 1 | 50% |
| Tree | | | | | | | |
| <i>Acacia constricta</i> | Native | 2 | 4 | 60% | 20.0% | 2 | 100% |
| <i>Acacia greggii</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Celtis laevigata</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Olneya tesota</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Parkinsonia microphylla</i> | Native | 5 | 4 | 90% | 10.0% | 2 | 100% |
| <i>Prosopis velutina</i> | Native | 0 | 1 | 10% | 10.0% | 1 | 50% |
| <i>Vauquelinia californica</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| Vine | | | | | | | |
| <i>Boerhavia scandens</i> | Native | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Janusia gracilis</i> | Native | 3 | 3 | 60% | 0.0% | 2 | 100% |
| N/A | | | | | | | |
| <i>Astrolepis</i> sp. | N/A | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Cirsium</i> sp. | N/A | 0 | 0 | 0% | 0.0% | 0 | 0% |

Table A4c. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, 202 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| Scientific name | Nativity | Within-plot frequency (0–5) | | | | | | Within-plot frequency (%) | | | |
|------------------------------------|----------|-----------------------------|---------|---------|---------|---------|---------|---------------------------|-------|---------|---------------------|
| | | 202_V01 | 202_V02 | 202_V03 | 202_V04 | 202_V05 | 202_V06 | Mean | SE | # sites | Landscape frequency |
| Forb/Herb | | | | | | | | | | | |
| <i>Acourtia wrightii</i> | Native | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Argythamnia neomexicana</i> | Native | 0 | 0 | 0 | 0 | 2 | 0 | 7% | 6.7% | 1 | 17% |
| <i>Artemisia ludoviciana</i> | Native | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Carlowrightia arizonica</i> | Native | 0 | 0 | 0 | 0 | 2 | 0 | 7% | 6.7% | 1 | 17% |
| <i>Chamaesyce</i> | N/A | 0 | 0 | 0 | 1 | 2 | 1 | 13% | 6.7% | 3 | 50% |
| <i>Cheilanthes lindheimeri</i> | Native | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0.0% | 0 | 0% |
| ANNUAL FORB | N/A | 0 | 1 | 1 | 5 | 5 | 5 | 57% | 19.6% | 5 | 83% |
| <i>Packera neomexicana</i> | Native | 0 | 0 | 1 | 0 | 0 | 0 | 3% | 3.3% | 1 | 17% |
| <i>Pellaea truncata</i> | Native | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Selaginella arizonica</i> | Native | 0 | 0 | 4 | 5 | 2 | 5 | 53% | 19.1% | 4 | 67% |
| <i>Tragia ramosa</i> | Native | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0.0% | 0 | 0% |
| Graminoid | | | | | | | | | | | |
| <i>Aristida purpurea</i> | Native | 0 | 0 | 1 | 0 | 0 | 0 | 3% | 3.3% | 1 | 17% |
| <i>Aristida ternipes</i> | Native | 5 | 0 | 0 | 1 | 3 | 0 | 30% | 16.9% | 3 | 50% |
| <i>Bouteloua curtipendula</i> | Native | 0 | 1 | 0 | 0 | 0 | 0 | 3% | 3.3% | 1 | 17% |
| <i>Bouteloua repens</i> | Native | 0 | 0 | 0 | 0 | 1 | 1 | 7% | 4.2% | 2 | 33% |
| <i>Digitaria californica</i> | Native | 0 | 0 | 0 | 1 | 0 | 0 | 3% | 3.3% | 1 | 17% |
| <i>Echinochloa</i> sp. | N/A | 1 | 5 | 4 | 0 | 0 | 0 | 33% | 18.4% | 3 | 50% |
| <i>Heteropogon contortus</i> | Native | 1 | 0 | 0 | 0 | 0 | 0 | 3% | 3.3% | 1 | 17% |
| <i>Hilaria belangeri</i> | Native | 0 | 0 | 0 | 0 | 0 | 2 | 7% | 6.7% | 1 | 17% |
| <i>Hilaria mutica</i> | Native | 2 | 4 | 5 | 1 | 0 | 0 | 40% | 17.1% | 4 | 67% |
| <i>Leptochloa dubia</i> | Native | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Muhlenbergia porteri</i> | Native | 1 | 0 | 0 | 4 | 3 | 0 | 27% | 14.3% | 3 | 50% |
| ANNUAL GRASS | N/A | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Tridens muticus</i> | Native | 0 | 0 | 0 | 5 | 0 | 0 | 17% | 16.7% | 1 | 17% |
| Subshrub | | | | | | | | | | | |
| <i>Abutilon incanum</i> | Native | 4 | 5 | 5 | 5 | 3 | 5 | 90% | 6.8% | 6 | 100% |
| <i>Acacia angustissima</i> | Native | 0 | 0 | 0 | 0 | 2 | 0 | 7% | 6.7% | 1 | 17% |
| <i>Adenophyllum porophylloides</i> | Native | 0 | 0 | 0 | 1 | 0 | 0 | 3% | 3.3% | 1 | 17% |
| <i>Ambrosia deltoidea</i> | Native | 5 | 0 | 0 | 2 | 1 | 4 | 40% | 17.1% | 4 | 67% |
| <i>Argythamnia lanceolata</i> | Native | 0 | 0 | 0 | 0 | 0 | 5 | 17% | 16.7% | 1 | 17% |
| <i>Ayenia filiformis</i> | Native | 0 | 0 | 0 | 0 | 0 | 1 | 3% | 3.3% | 1 | 17% |
| <i>Baccharis brachyphylla</i> | Native | 0 | 0 | 0 | 0 | 2 | 0 | 7% | 6.7% | 1 | 17% |
| <i>Brickellia coulteri</i> | Native | 0 | 0 | 0 | 1 | 1 | 0 | 7% | 4.2% | 2 | 33% |
| <i>Encelia farinosa</i> | Native | 5 | 2 | 2 | 5 | 5 | 5 | 80% | 12.6% | 6 | 100% |
| <i>Ericameria laricifolia</i> | Native | 0 | 1 | 0 | 0 | 0 | 0 | 3% | 3.3% | 1 | 17% |
| <i>Eriogonum wrightii</i> | Native | 0 | 0 | 0 | 1 | 0 | 0 | 3% | 3.3% | 1 | 17% |
| <i>Herissantia crispa</i> | Native | 0 | 0 | 0 | 2 | 2 | 0 | 13% | 8.4% | 2 | 33% |
| <i>Hibiscus coulteri</i> | Native | 0 | 0 | 0 | 1 | 0 | 0 | 3% | 3.3% | 1 | 17% |

Table A4c. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, 202 stratum, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Scientific name | Nativity | Within-plot frequency (0–5) | | | | | | Within-plot frequency (%) | | | |
|--------------------------------------|----------|-----------------------------|---------|---------|---------|---------|---------|---------------------------|-------|---------|---------------------|
| | | 202_V01 | 202_V02 | 202_V03 | 202_V04 | 202_V05 | 202_V06 | Mean | SE | # sites | Landscape frequency |
| Subshrub, cont. | | | | | | | | | | | |
| <i>Hibiscus denudatus</i> | Native | 0 | 0 | 0 | 1 | 0 | 0 | 3% | 3.3% | 1 | 17% |
| <i>Koanophyllon solidaginifolium</i> | Native | 0 | 0 | 0 | 0 | 2 | 0 | 7% | 6.7% | 1 | 17% |
| <i>Krameria grayi</i> | Native | 0 | 0 | 0 | 0 | 2 | 0 | 7% | 6.7% | 1 | 17% |
| <i>Menodora scabra</i> | Native | 0 | 4 | 5 | 3 | 2 | 2 | 53% | 14.3% | 5 | 83% |
| <i>Phoradendron californicum</i> | Native | 3 | 0 | 2 | 0 | 1 | 0 | 20% | 10.3% | 3 | 50% |
| <i>Porophyllum gracile</i> | Native | 0 | 0 | 0 | 1 | 1 | 0 | 7% | 4.2% | 2 | 33% |
| <i>Sphaeralcea</i> | N/A | 0 | 0 | 0 | 5 | 0 | 0 | 17% | 16.7% | 1 | 17% |
| <i>Stephanomeria pauciflora</i> | Native | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Trixis californica</i> | Native | 2 | 0 | 0 | 1 | 3 | 0 | 20% | 10.3% | 3 | 50% |
| <i>Zinnia acerosa</i> | Native | 0 | 1 | 0 | 0 | 0 | 0 | 3% | 3.3% | 1 | 17% |
| Shrub | | | | | | | | | | | |
| <i>Aloysia wrightii</i> | Native | 0 | 0 | 1 | 0 | 0 | 0 | 3% | 3.3% | 1 | 17% |
| <i>Atriplex canescens</i> | Native | 0 | 0 | 0 | 0 | 0 | 1 | 3% | 3.3% | 1 | 17% |
| <i>Calliandra eriophylla</i> | Native | 5 | 5 | 5 | 4 | 4 | 5 | 93% | 4.2% | 6 | 100% |
| <i>Celtis ehrenbergiana</i> | Native | 0 | 0 | 0 | 1 | 1 | 0 | 7% | 4.2% | 2 | 33% |
| <i>Crossosoma bigelovii</i> | Native | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Ephedra trifurca</i> | Native | 0 | 0 | 0 | 0 | 0 | 4 | 13% | 13.3% | 1 | 17% |
| <i>Fouquieria splendens</i> | Native | 5 | 3 | 2 | 2 | 3 | 3 | 60% | 8.9% | 6 | 100% |
| <i>Hyptis emoryi</i> | Native | 0 | 0 | 0 | 0 | 1 | 0 | 3% | 3.3% | 1 | 17% |
| <i>Jatropha cardiophylla</i> | Native | 3 | 1 | 0 | 1 | 1 | 0 | 20% | 8.9% | 4 | 67% |
| <i>Larrea tridentata</i> | Native | 0 | 0 | 0 | 1 | 0 | 1 | 7% | 4.2% | 2 | 33% |
| <i>Lycium</i> | N/A | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Lycium andersonii</i> | Native | 4 | 5 | 4 | 0 | 0 | 0 | 43% | 19.6% | 3 | 50% |
| <i>Lycium berlandieri</i> | Native | 0 | 0 | 0 | 5 | 4 | 5 | 47% | 21.1% | 3 | 50% |
| <i>Lycium fremontii</i> | Native | 0 | 0 | 0 | 0 | 0 | 1 | 3% | 3.3% | 1 | 17% |
| <i>Matelea parvifolia</i> | Native | 0 | 0 | 0 | 0 | 0 | 1 | 3% | 3.3% | 1 | 17% |
| SNAG | N/A | 3 | 4 | 2 | 4 | 5 | 5 | 77% | 9.5% | 6 | 100% |
| <i>Simmondsia chinensis</i> | Native | 0 | 5 | 5 | 5 | 0 | 0 | 50% | 22.4% | 3 | 50% |
| <i>Ziziphus obtusifolia</i> | Native | 0 | 0 | 0 | 1 | 0 | 2 | 10% | 6.8% | 2 | 33% |
| Succulent | | | | | | | | | | | |
| <i>Agave schottii</i> | Native | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Carnegiea gigantea</i> | Native | 5 | 3 | 2 | 5 | 1 | 5 | 70% | 14.4% | 6 | 100% |
| <i>Cylindropuntia acanthocarpa</i> | Native | 0 | 5 | 0 | 4 | 5 | 5 | 63% | 20.3% | 4 | 67% |
| <i>Cylindropuntia arbuscula</i> | Native | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Cylindropuntia bigelovii</i> | Native | 0 | 0 | 0 | 3 | 0 | 0 | 10% | 10.0% | 1 | 17% |
| <i>Cylindropuntia fulgida</i> | Native | 0 | 0 | 0 | 0 | 1 | 0 | 3% | 3.3% | 1 | 17% |
| <i>Cylindropuntia leptocaulis</i> | Native | 2 | 1 | 5 | 0 | 0 | 2 | 33% | 15.2% | 4 | 67% |
| <i>Dasyliirion wheeleri</i> | Native | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Echinocereus engelmannii</i> | Native | 0 | 0 | 0 | 1 | 2 | 1 | 13% | 6.7% | 3 | 50% |

Table A4c. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, 202 stratum, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Scientific name | Nativity | Within-plot frequency (0–5) | | | | | | Within-plot frequency (%) | | | |
|--------------------------------|----------|-----------------------------|---------|---------|---------|---------|---------|---------------------------|-------|---------|---------------------|
| | | 202_V01 | 202_V02 | 202_V03 | 202_V04 | 202_V05 | 202_V06 | Mean | SE | # sites | Landscape frequency |
| Succulent, cont. | | | | | | | | | | | |
| <i>Ferocactus wislizeni</i> | Native | 3 | 4 | 3 | 1 | 3 | 4 | 60% | 8.9% | 6 | 100% |
| <i>Mammillaria</i> | N/A | 3 | 0 | 0 | 0 | 0 | 0 | 10% | 10.0% | 1 | 17% |
| <i>Mammillaria grahamii</i> | Native | 0 | 0 | 0 | 0 | 0 | 2 | 7% | 6.7% | 1 | 17% |
| <i>Opuntia chlorotica</i> | Native | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Opuntia engelmannii</i> | Native | 4 | 5 | 5 | 0 | 4 | 0 | 60% | 19.3% | 4 | 67% |
| <i>Opuntia phaeacantha</i> | Native | 0 | 0 | 0 | 1 | 2 | 0 | 10% | 6.8% | 2 | 33% |
| Tree | | | | | | | | | | | |
| <i>Acacia constricta</i> | Native | 3 | 1 | 3 | 2 | 5 | 4 | 60% | 11.5% | 6 | 100% |
| <i>Acacia greggii</i> | Native | 0 | 4 | 2 | 5 | 2 | 0 | 43% | 16.7% | 4 | 67% |
| <i>Celtis laevigata</i> | Native | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0.0% | 0 | 0% |
| <i>Olneya tesota</i> | Native | 4 | 0 | 0 | 0 | 1 | 0 | 17% | 13.1% | 2 | 33% |
| <i>Parkinsonia microphylla</i> | Native | 5 | 0 | 5 | 5 | 5 | 5 | 83% | 16.7% | 5 | 83% |
| <i>Prosopis velutina</i> | Native | 0 | 2 | 2 | 0 | 1 | 3 | 27% | 9.9% | 4 | 67% |
| <i>Vauquelinia californica</i> | Native | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0.0% | 0 | 0% |
| Vine | | | | | | | | | | | |
| <i>Boerhavia scandens</i> | Native | 0 | 0 | 0 | 2 | 0 | 0 | 7% | 6.7% | 1 | 17% |
| <i>Janusia gracilis</i> | Native | 5 | 5 | 5 | 5 | 5 | 5 | 100% | 0.0% | 6 | 100% |
| N/A | | | | | | | | | | | |
| <i>Astrolepis</i> sp. | N/A | 0 | 0 | 0 | 1 | 0 | 0 | 3% | 3.3% | 1 | 17% |
| <i>Cirsium</i> sp. | N/A | 0 | 0 | 0 | 0 | 0 | 0 | 0% | 0.0% | 0 | 0% |

Table A4d. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, 302 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| Scientific name | Nativity | Within-plot frequency (0–5) | Within-plot frequency (%) | | | |
|------------------------------------|----------|-----------------------------|---------------------------|-----|---------|---------------------|
| | | 302_V02 | Mean | SE | # sites | Landscape frequency |
| Forb/Herb | | | | | | |
| <i>Acourtia wrightii</i> | Native | 2 | 40% | n/a | 1 | 100% |
| <i>Argythamnia neomexicana</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Artemisia ludoviciana</i> | Native | 5 | 100% | n/a | 1 | 100% |
| <i>Carlowrightia arizonica</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Chamaesyce</i> | N/A | 3 | 60% | n/a | 1 | 100% |
| <i>Cheilanthes lindheimeri</i> | Native | 1 | 20% | n/a | 1 | 100% |
| ANNUAL FORB | N/A | 1 | 20% | n/a | 1 | 100% |
| <i>Packera neomexicana</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Pellaea truncata</i> | Native | 4 | 80% | n/a | 1 | 100% |
| <i>Selaginella arizonica</i> | Native | 5 | 100% | n/a | 1 | 100% |
| <i>Tragia ramosa</i> | Native | 3 | 60% | n/a | 1 | 100% |
| Graminoid | | | | | | |
| <i>Aristida purpurea</i> | Native | 1 | 20% | n/a | 1 | 100% |
| <i>Aristida ternipes</i> | Native | 4 | 80% | n/a | 1 | 100% |
| <i>Bouteloua curtipendula</i> | Native | 5 | 100% | n/a | 1 | 100% |
| <i>Bouteloua repens</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Digitaria californica</i> | Native | 5 | 100% | n/a | 1 | 100% |
| <i>Echinochloa</i> sp. | N/A | 1 | 20% | n/a | 1 | 100% |
| <i>Heteropogon contortus</i> | Native | 1 | 20% | n/a | 1 | 100% |
| <i>Hilaria belangeri</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Hilaria mutica</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Leptochloa dubia</i> | Native | 1 | 20% | n/a | 1 | 100% |
| <i>Muhlenbergia porteri</i> | Native | 5 | 100% | n/a | 1 | 100% |
| ANNUAL GRASS | N/A | 0 | 0% | n/a | 0 | 0% |
| <i>Tridens muticus</i> | Native | 0 | 0% | n/a | 0 | 0% |
| Subshrub | | | | | | |
| <i>Abutilon incanum</i> | Native | 1 | 20% | n/a | 1 | 100% |
| <i>Acacia angustissima</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Adenophyllum porophylloides</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Ambrosia deltoidea</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Argythamnia lanceolata</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Ayenia filiformis</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Baccharis brachyphylla</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Brickellia coulteri</i> | Native | 2 | 40% | n/a | 1 | 100% |
| <i>Encelia farinosa</i> | Native | 1 | 20% | n/a | 1 | 100% |
| <i>Ericameria laricifolia</i> | Native | 2 | 40% | n/a | 1 | 100% |
| <i>Eriogonum wrightii</i> | Native | 5 | 100% | n/a | 1 | 100% |
| <i>Herissantia crispa</i> | Native | 0 | 0% | n/a | 0 | 0% |

Table A4d. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, 302 stratum, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Scientific name | Nativity | Within-plot frequency (0–5) | Within-plot frequency (%) | | | |
|--------------------------------------|----------|-----------------------------|---------------------------|-----|---------|---------------------|
| | | 302_V02 | Mean | SE | # sites | Landscape frequency |
| Subshrub, cont. | | | | | | |
| <i>Hibiscus coulteri</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Hibiscus denudatus</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Koanophyllon solidaginifolium</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Krameria grayi</i> | Native | 2 | 40% | n/a | 1 | 100% |
| <i>Menodora scabra</i> | Native | 4 | 80% | n/a | 1 | 100% |
| <i>Phoradendron californicum</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Porophyllum gracile</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Sphaeralcea</i> | N/A | 1 | 20% | n/a | 1 | 100% |
| <i>Stephanomeria pauciflora</i> | Native | 1 | 20% | n/a | 1 | 100% |
| <i>Trixis californica</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Zinnia acerosa</i> | Native | 1 | 20% | n/a | 1 | 100% |
| Shrub | | | | | | |
| <i>Aloisia wrightii</i> | Native | 5 | 100% | n/a | 1 | 100% |
| <i>Atriplex canescens</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Calliandra eriophylla</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Celtis ehrenbergiana</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Crossosoma bigelovii</i> | Native | 1 | 20% | n/a | 1 | 100% |
| <i>Ephedra trifurca</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Fouquieria splendens</i> | Native | 3 | 60% | n/a | 1 | 100% |
| <i>Hyptis emoryi</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Jatropha cardiophylla</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Larrea tridentata</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Lycium</i> | N/A | 0 | 0% | n/a | 0 | 0% |
| <i>Lycium andersonii</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Lycium berlandieri</i> | Native | 1 | 20% | n/a | 1 | 100% |
| <i>Lycium fremontii</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Matelea parvifolia</i> | Native | 0 | 0% | n/a | 0 | 0% |
| SNAG | N/A | 2 | 40% | n/a | 1 | 100% |
| <i>Simmondsia chinensis</i> | Native | 5 | 100% | n/a | 1 | 100% |
| <i>Ziziphus obtusifolia</i> | Native | 0 | 0% | n/a | 0 | 0% |
| Succulent | | | | | | |
| <i>Agave schottii</i> | Native | 2 | 40% | n/a | 1 | 100% |
| <i>Carnegiea gigantea</i> | Native | 1 | 20% | n/a | 1 | 100% |
| <i>Cylindropuntia acanthocarpa</i> | Native | 5 | 100% | n/a | 1 | 100% |
| <i>Cylindropuntia arbuscula</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Cylindropuntia bigelovii</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Cylindropuntia fulgida</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Cylindropuntia leptocaulis</i> | Native | 0 | 0% | n/a | 0 | 0% |

Table A4d. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, 302 stratum, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Scientific name | Nativity | Within-plot frequency (0–5) | Within-plot frequency (%) | | | |
|---------------------------------|----------|-----------------------------|---------------------------|-----|---------|---------------------|
| | | 302_V02 | Mean | SE | # sites | Landscape frequency |
| Succulent, cont. | | | | | | |
| <i>Dasyliirion wheeleri</i> | Native | 5 | 100% | n/a | 1 | 100% |
| <i>Echinocereus engelmannii</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Ferocactus wislizeni</i> | Native | 2 | 40% | n/a | 1 | 100% |
| <i>Mammillaria</i> | N/A | 0 | 0% | n/a | 0 | 0% |
| <i>Mammillaria grahamii</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Opuntia chlorotica</i> | Native | 2 | 40% | n/a | 1 | 100% |
| <i>Opuntia engelmannii</i> | Native | 5 | 100% | n/a | 1 | 100% |
| <i>Opuntia phaeacantha</i> | Native | 3 | 60% | n/a | 1 | 100% |
| Tree | | | | | | |
| <i>Acacia constricta</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Acacia greggii</i> | Native | 3 | 60% | n/a | 1 | 100% |
| <i>Celtis laevigata</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Olneya tesota</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Parkinsonia microphylla</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Prosopis velutina</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Vauquelinia californica</i> | Native | 2 | 40% | n/a | 1 | 100% |
| Vine | | | | | | |
| <i>Boerhavia scandens</i> | Native | 0 | 0% | n/a | 0 | 0% |
| <i>Janusia gracilis</i> | Native | 3 | 60% | n/a | 1 | 100% |
| N/A | | | | | | |
| <i>Astrolepis</i> sp. | N/A | 0 | 0% | n/a | 0 | 0% |
| <i>Cirsium</i> sp. | N/A | 1 | 20% | n/a | 1 | 100% |

Table A4e. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, all strata, Tucson Mountain District, Saguaro NP, 2009–2010.

| Scientific name | Nativity | Within-plot frequency (%) | | | | | | |
|------------------------------------|------------|---------------------------|------------|----------|---------------------|------------|------------|-----------|
| | | Mean | SE | # sites | Landscape frequency | Sdiff | MDC | n |
| Forb/Herb | | | | | | | | |
| <i>Acourtia wrightii</i> | Native | 4% | 4% | 1 | 5% | 9% | 5% | 25 |
| <i>Argythamnia neomexicana</i> | Native | 4% | 4% | 1 | 5% | 9% | 5% | 25 |
| <i>Artemisia ludoviciana</i> | Native | 9% | 9% | 1 | 5% | 21% | 12% | 27 |
| <i>Carlowrightia arizonica</i> | Native | 5% | 4% | 2 | 10% | 9% | 6% | 20 |
| <i>Chamaesyce</i> | N/A | 18% | 7% | 5 | 25% | 17% | 10% | 26 |
| <i>Cheilanthes lindheimeri</i> | Native | 2% | 2% | 1 | 5% | 4% | 5% | 7 |
| ANNUAL FORB | N/A | 42% | 14% | 7 | 35% | 33% | 19% | 26 |
| <i>Packera neomexicana</i> | Native | 2% | 2% | 1 | 5% | 4% | 5% | 7 |
| <i>Pellaea truncata</i> | Native | 7% | 7% | 1 | 5% | 17% | 10% | 25 |
| <i>Selaginella arizonica</i> | Native | 38% | 14% | 5 | 25% | 33% | 19% | 26 |
| <i>Tragia ramosa</i> | Native | 5% | 5% | 1 | 5% | 13% | 8% | 22 |
| Graminoid | | | | | | | | |
| <i>Aristida purpurea</i> | Native | 5% | 3% | 3 | 15% | 7% | 5% | 15 |
| <i>Aristida ternipes</i> | Native | 24% | 11% | 4 | 20% | 27% | 16% | 24 |
| <i>Bouteloua curtipendula</i> | Native | 11% | 9% | 2 | 10% | 21% | 12% | 27 |
| <i>Bouteloua repens</i> | Native | 4% | 2% | 2 | 10% | 6% | 5% | 12 |
| <i>Digitaria californica</i> | Native | 11% | 9% | 2 | 10% | 21% | 12% | 27 |
| <i>Echinochloa</i> sp. | N/A | 20% | 11% | 4 | 20% | 25% | 15% | 25 |
| <i>Heteropogon contortus</i> | Native | 4% | 2% | 2 | 10% | 6% | 5% | 12 |
| <i>Hilaria belangeri</i> | Native | 4% | 4% | 1 | 5% | 9% | 5% | 25 |
| <i>Hilaria mutica</i> | Native | 22% | 11% | 4 | 20% | 26% | 15% | 25 |
| <i>Leptochloa dubia</i> | Native | 2% | 2% | 1 | 5% | 4% | 5% | 7 |
| <i>Muhlenbergia porteri</i> | Native | 24% | 11% | 4 | 20% | 27% | 16% | 24 |
| ANNUAL GRASS | N/A | 5% | 4% | 2 | 10% | 9% | 6% | 20 |
| <i>Tridens muticus</i> | Native | 9% | 9% | 1 | 5% | 21% | 12% | 27 |
| Subshrub | | | | | | | | |
| <i>Abutilon incanum</i> | Native | 58% | 12% | 9 | 45% | 29% | 17% | 26 |
| <i>Acacia angustissima</i> | Native | 4% | 4% | 1 | 5% | 9% | 5% | 25 |
| <i>Adenophyllum porophylloides</i> | Native | 2% | 2% | 1 | 5% | 4% | 5% | 7 |
| <i>Ambrosia deltoidea</i> | Native | 53% | 13% | 8 | 40% | 31% | 18% | 26 |
| <i>Argythamnia lanceolata</i> | Native | 9% | 9% | 1 | 5% | 21% | 12% | 27 |
| <i>Ayenia filiformis</i> | Native | 2% | 2% | 1 | 5% | 4% | 5% | 7 |
| <i>Baccharis brachyphylla</i> | Native | 4% | 4% | 1 | 5% | 9% | 5% | 25 |
| <i>Brickellia coulteri</i> | Native | 7% | 4% | 3 | 15% | 10% | 6% | 22 |
| <i>Encelia farinosa</i> | Native | 64% | 13% | 9 | 45% | 31% | 18% | 26 |
| <i>Ericameria laricifolia</i> | Native | 5% | 4% | 2 | 10% | 9% | 6% | 20 |
| <i>Eriogonum wrightii</i> | Native | 11% | 9% | 2 | 10% | 21% | 12% | 27 |
| <i>Herissantia crispa</i> | Native | 7% | 5% | 2 | 10% | 11% | 7% | 23 |
| <i>Hibiscus coulteri</i> | Native | 2% | 2% | 1 | 5% | 4% | 5% | 7 |
| <i>Hibiscus denudatus</i> | Native | 2% | 2% | 1 | 5% | 4% | 5% | 7 |

Table A4e. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, all strata, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Scientific name | Nativity | Within-plot frequency (%) | | | | | | |
|--------------------------------------|----------|---------------------------|-----|---------|---------------------|-------|-----|----|
| | | Mean | SE | # sites | Landscape frequency | Sdiff | MDC | n |
| Subshrub, cont. | | | | | | | | |
| <i>Koanophyllon solidaginifolium</i> | Native | 4% | 4% | 1 | 5% | 9% | 5% | 25 |
| <i>Krameria grayi</i> | Native | 24% | 11% | 4 | 20% | 26% | 15% | 26 |
| <i>Menodora scabra</i> | Native | 51% | 11% | 8 | 40% | 26% | 15% | 27 |
| <i>Phoradendron californicum</i> | Native | 13% | 6% | 4 | 20% | 15% | 9% | 23 |
| <i>Porophyllum gracile</i> | Native | 7% | 4% | 3 | 15% | 10% | 6% | 22 |
| <i>Sphaeralcea</i> | N/A | 11% | 9% | 2 | 10% | 21% | 12% | 27 |
| <i>Stephanomeria pauciflora</i> | Native | 2% | 2% | 1 | 5% | 4% | 5% | 7 |
| <i>Trixis californica</i> | Native | 11% | 6% | 3 | 15% | 15% | 9% | 23 |
| <i>Zinnia acerosa</i> | Native | 4% | 2% | 2 | 10% | 6% | 5% | 12 |
| Shrub | | | | | | | | |
| <i>Aloysia wrightii</i> | Native | 11% | 9% | 2 | 10% | 21% | 12% | 27 |
| <i>Atriplex canescens</i> | Native | 2% | 2% | 1 | 5% | 4% | 5% | 7 |
| <i>Calliandra eriophylla</i> | Native | 62% | 14% | 8 | 40% | 33% | 19% | 25 |
| <i>Celtis ehrenbergiana</i> | Native | 5% | 3% | 3 | 15% | 7% | 5% | 15 |
| <i>Crossosoma bigelovii</i> | Native | 2% | 2% | 1 | 5% | 4% | 5% | 7 |
| <i>Ephedra trifurca</i> | Native | 7% | 7% | 1 | 5% | 17% | 10% | 25 |
| <i>Fouquieria splendens</i> | Native | 42% | 9% | 9 | 45% | 21% | 13% | 24 |
| <i>Hyptis emoryi</i> | Native | 2% | 2% | 1 | 5% | 4% | 5% | 7 |
| <i>Jatropha cardiophylla</i> | Native | 16% | 7% | 5 | 25% | 17% | 10% | 24 |
| <i>Larrea tridentata</i> | Native | 18% | 8% | 5 | 25% | 18% | 11% | 24 |
| <i>Lycium</i> | N/A | 4% | 4% | 1 | 5% | 9% | 5% | 25 |
| <i>Lycium andersonii</i> | Native | 29% | 12% | 4 | 20% | 29% | 17% | 26 |
| <i>Lycium berlandieri</i> | Native | 36% | 14% | 5 | 25% | 33% | 19% | 27 |
| <i>Lycium fremontii</i> | Native | 5% | 4% | 2 | 10% | 9% | 6% | 20 |
| <i>Matelea parvifolia</i> | Native | 2% | 2% | 1 | 5% | 4% | 5% | 7 |
| SNAG | N/A | 75% | 8% | 11 | 55% | 18% | 11% | 23 |
| <i>Simmondsia chinensis</i> | Native | 36% | 15% | 4 | 20% | 36% | 21% | 25 |
| <i>Ziziphus obtusifolia</i> | Native | 5% | 4% | 2 | 10% | 9% | 6% | 20 |
| Succulent | | | | | | | | |
| <i>Agave schottii</i> | Native | 4% | 4% | 1 | 5% | 9% | 5% | 25 |
| <i>Carnegiea gigantea</i> | Native | 69% | 10% | 11 | 55% | 23% | 13% | 27 |
| <i>Cylindropuntia acanthocarpa</i> | Native | 67% | 13% | 8 | 40% | 31% | 18% | 26 |
| <i>Cylindropuntia arbuscula</i> | Native | 9% | 7% | 2 | 10% | 17% | 10% | 26 |
| <i>Cylindropuntia bigelovii</i> | Native | 13% | 9% | 2 | 10% | 20% | 12% | 25 |
| <i>Cylindropuntia fulgida</i> | Native | 4% | 2% | 2 | 10% | 6% | 5% | 12 |
| <i>Cylindropuntia leptocaulis</i> | Native | 35% | 11% | 7 | 35% | 27% | 16% | 25 |
| <i>Dasyliirion wheeleri</i> | Native | 9% | 9% | 1 | 5% | 21% | 12% | 27 |
| <i>Echinocereus engelmannii</i> | Native | 13% | 5% | 5 | 25% | 11% | 7% | 23 |
| <i>Ferocactus wislizeni</i> | Native | 58% | 6% | 11 | 55% | 13% | 8% | 24 |
| <i>Mammillaria</i> | N/A | 11% | 6% | 3 | 15% | 15% | 9% | 23 |
| <i>Mammillaria grahamii</i> | Native | 15% | 8% | 3 | 15% | 19% | 11% | 26 |

Table A4e. Within-plot and landscape frequency (%) for all plots and species sampled on monitoring plots, all strata, Tucson Mountain District, Saguaro NP, 2009–2010, cont.

| Scientific name | Nativity | Within-plot frequency (%) | | | | | | |
|--------------------------------|----------|---------------------------|-----|---------|---------------------|-------|-----|----|
| | | Mean | SE | # sites | Landscape frequency | Sdiff | MDC | n |
| Succulent, cont. | | | | | | | | |
| <i>Opuntia chlorotica</i> | Native | 4% | 4% | 1 | 5% | 9% | 5% | 25 |
| <i>Opuntia engelmannii</i> | Native | 58% | 13% | 9 | 45% | 30% | 17% | 27 |
| <i>Opuntia phaeacantha</i> | Native | 27% | 11% | 5 | 25% | 26% | 15% | 27 |
| Tree | | | | | | | | |
| <i>Acacia constricta</i> | Native | 53% | 9% | 10 | 50% | 20% | 12% | 25 |
| <i>Acacia greggii</i> | Native | 29% | 11% | 5 | 25% | 26% | 15% | 27 |
| <i>Celtis laevigata</i> | Native | 2% | 2% | 1 | 5% | 4% | 5% | 7 |
| <i>Olneya tesota</i> | Native | 16% | 10% | 3 | 15% | 23% | 13% | 26 |
| <i>Parkinsonia microphylla</i> | Native | 71% | 12% | 9 | 45% | 29% | 17% | 25 |
| <i>Prosopis velutina</i> | Native | 16% | 7% | 5 | 25% | 15% | 9% | 25 |
| <i>Vauquelinia californica</i> | Native | 4% | 4% | 1 | 5% | 9% | 5% | 25 |
| Vine | | | | | | | | |
| <i>Boerhavia scandens</i> | Native | 4% | 4% | 1 | 5% | 9% | 5% | 25 |
| <i>Janusia gracilis</i> | Native | 71% | 12% | 9 | 45% | 28% | 16% | 26 |
| N/A | | | | | | | | |
| <i>Astrolepis</i> sp. | N/A | 2% | 2% | 1 | 5% | 4% | 5% | 7 |
| <i>Cirsium</i> sp. | N/A | 2% | 2% | 1 | 5% | 4% | 5% | 7 |

Table A5a. Soil substrate (% by class) and surface aggregate stability class (mean and SE) and proportion of samples in "very stable" (=6) category, by monitoring plot, 101 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| | Individual plot measures | | Across-plot measures | | | | | |
|---|--------------------------|---------|----------------------|-------|-------|-------|-----|----|
| | 101_V01 | 101_V02 | AVG | STD | SE | Sdiff | MDC | n= |
| Parameter | | | | | | | | |
| Substrate | | | | | | | | |
| Bare soil (<2 mm) - no overhead cover | 9% | 4% | 6.5% | 3.8% | 2.7% | 2.7% | 5% | 3 |
| Bare soil (<2 mm) - under vegetation | 4% | 5% | 4.6% | 1.2% | 0.8% | 0.8% | 5% | 1 |
| Litter and duff (organic matter) | 9% | 1% | 5.2% | 5.6% | 4.0% | 4.0% | 7% | 3 |
| Light cyanobacteria | 12% | 2% | 6.9% | 7.4% | 5.2% | 5.2% | 9% | 3 |
| Dark cyanobacteria | 2% | 0% | 0.8% | 1.2% | 0.8% | 0.8% | 5% | 1 |
| Lichen | 1% | 0% | 0.6% | 0.9% | 0.6% | 0.6% | 5% | 1 |
| Moss | 0% | 0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Plant base | 0% | 1% | 0.4% | 0.6% | 0.4% | 0.4% | 5% | 1 |
| Gravel (2–75 mm) | 63% | 84% | 73.3% | 14.7% | 10.4% | 10.4% | 18% | 3 |
| Rock (76–600 mm) | 0% | 3% | 1.5% | 2.1% | 1.5% | 1.5% | 5% | 1 |
| Lichen on rock | 0% | 0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Bedrock | 0% | 0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Surface Soil Aggregate Stability | | | | | | | | |
| Under vegetation | | | | | | | | |
| Average soil stability | 4.67 | 4.00 | 4.33 | 0.47 | 0.33 | 0.33 | 0.6 | 3 |
| SD | 1.72 | 1.46 | | | | | | |
| SE | 0.44 | 0.38 | | | | | | |
| % samples "very stable" | 47% | 13% | 30% | 24% | 17% | 17% | 29% | 3 |
| n | 15 | 15 | | | | | | |
| No vegetation cover | | | | | | | | |
| Average soil stability | 4.00 | 2.97 | 3.48 | 0.73 | 0.52 | 0.52 | 0.9 | 3 |
| SD | 1.94 | 1.16 | | | | | | |
| SE | 0.34 | 0.20 | | | | | | |
| % samples "very stable" | 30% | 0% | 15% | 21% | 15% | 15% | 26% | 3 |
| n | 33 | | | | | | | |

Decreasing erosion hazard ↓

"n" = number of samples collected per plot.
Red denotes values below a management assessment point.

Table A5b. Soil substrate (% by class) and surface aggregate stability class (mean and SE) and proportion of samples in "very stable" (=6) category, by monitoring plot, 102 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| Parameter | Individual plot measures | | Across-plot measures | | | | | |
|---|--------------------------|---------|----------------------|-------|-------|-------|-----|----|
| | 102_V01 | 102_V02 | AVG | STD | SE | Sdiff | MDC | n= |
| Substrate | | | | | | | | |
| Bare soil (<2 mm) - no overhead cover | 4% | 1% | 2.5% | 1.8% | 1.3% | 1.3% | 5% | 1 |
| Bare soil (<2 mm) - under vegetation | 5% | 5% | 5.0% | 0.0% | 0.0% | 0.0% | 5% | 1 |
| Litter and duff (organic matter) | 5% | 26% | 15.6% | 15.0% | 10.6% | 10.6% | 18% | 3 |
| Light cyanobacteria | 0% | 11% | 5.4% | 7.7% | 5.4% | 5.4% | 10% | 3 |
| Dark cyanobacteria | 0% | 0% | 0.2% | 0.3% | 0.2% | 0.2% | 5% | 1 |
| Lichen | 0% | 0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Moss | 0% | 0% | 0.0% | 0.0% | 0.0% | 0.0% | 5% | 0 |
| Plant base | 3% | 0% | 1.5% | 1.5% | 1.0% | 1.0% | 5% | 1 |
| Gravel (2–75 mm) | 57% | 13% | 34.6% | 31.2% | 22.1% | 22.1% | 38% | 3 |
| Rock (76–600 mm) | 16% | 37% | 26.5% | 15.0% | 10.6% | 10.6% | 18% | 3 |
| Lichen on rock | 0% | 4% | 2.1% | 2.9% | 2.1% | 2.1% | 5% | 2 |
| Bedrock | 11% | 2% | 6.7% | 6.5% | 4.6% | 4.6% | 8% | 3 |
| Surface Soil Aggregate Stability | | | | | | | | |
| Under vegetation | | | | | | | | |
| Average soil stability | 3.79 | 4.58 | 4.19 | 0.56 | 0.40 | 0.40 | 0.7 | 3 |
| SD | 1.56 | 1.18 | | | | | | |
| SE | 0.32 | 0.24 | | | | | | |
| % samples "very stable" | 8% | 21% | 14.6% | 8.8% | 6.3% | 6.3% | 11% | 3 |
| n | 24 | 24 | | | | | | |
| No vegetation cover | | | | | | | | |
| Average soil stability | 2.30 | 3.67 | 2.99 | 0.96 | 0.68 | 0.68 | 1.2 | 3 |
| SD | 1.66 | 1.31 | | | | | | |
| SE | 0.35 | 0.27 | | | | | | |
| % samples "very stable" | 4% | 8% | 6.3% | 2.8% | 2.0% | 2.0% | 5% | 2 |
| n | 23 | 24 | | | | | | |

Decreasing erosion hazard ↓

"n" = number of samples collected per plot.
Red denotes values below a management assessment point.

Table A5c. Soil substrate (% by class) and surface aggregate stability class (mean and SE) and proportion of samples in "very stable" (=6) category, by monitoring plot, 202 stratum, Tucson Mountain District, Saguro NP, 2009–2010.

| Parameter | Individual plot measures | | | | | Across-plot measures | | | | | | |
|---|--------------------------|---------|---------|---------|---------|----------------------|-------|-------|------|-------|-----|----|
| | 202_V01 | 202_V02 | 202_V03 | 202_V04 | 202_V05 | 202_V06 | AVG | STD | SE | Sdiff | MDC | n= |
| Substrate | | | | | | | | | | | | |
| Bare soil (<2 mm) - no overhead cover | 4% | 3% | 5% | 3% | 4% | 4% | 3.7% | 0.8% | 0.3% | 0.5% | 5% | 1 |
| Bare soil (<2 mm) - under vegetation | 0% | 6% | 4% | 7% | 4% | 3% | 4.0% | 2.3% | 0.9% | 1.6% | 5% | 1 |
| Litter and duff (organic matter) | 13% | 16% | 26% | 20% | 27% | 15% | 19.4% | 5.9% | 2.4% | 4.2% | 5% | 6 |
| Light cyanobacteria | 0% | 0% | 0% | 2% | 0% | 11% | 2.2% | 4.3% | 1.8% | 3.0% | 5% | 4 |
| Dark cyanobacteria | 0% | 0% | 0% | 0% | 0% | 0% | 0.1% | 0.2% | 0.1% | 0.1% | 5% | 1 |
| Lichen | 0% | 0% | 0% | 0% | 0% | 0% | 0.1% | 0.2% | 0.1% | 0.1% | 5% | 1 |
| Moss | 0% | 38% | 10% | 11% | 5% | 5% | 11.5% | 13.6% | 5.5% | 9.6% | 8% | 13 |
| Plant base | 1% | 3% | 4% | 0% | 3% | 0% | 1.7% | 1.5% | 0.6% | 1.0% | 5% | 1 |
| Gravel (2–75 mm) | 79% | 22% | 44% | 36% | 45% | 11% | 39.4% | 23.3% | 9.5% | 16.5% | 13% | 14 |
| Rock (76–600 mm) | 4% | 9% | 7% | 14% | 13% | 25% | 11.9% | 7.5% | 3.1% | 5.3% | 5% | 10 |
| Lichen on rock | 0% | 0% | 0% | 1% | 0% | 25% | 4.4% | 10.1% | 4.1% | 7.1% | 6% | 13 |
| Bedrock | 1% | 5% | 0% | 6% | 0% | 0% | 2.0% | 2.5% | 1.0% | 1.8% | 5% | 2 |
| Surface Soil Aggregate Stability | | | | | | | | | | | | |
| Under vegetation | | | | | | | | | | | | |
| Average soil stability | 3.42 | 5.48 | 4.43 | 4.93 | 5.27 | 4.00 | 4.59 | 0.79 | 0.32 | 0.56 | 0.5 | 11 |
| SD | 1.69 | 1.37 | 1.89 | 1.82 | 1.20 | 1.95 | | | | | | |
| SE | 0.34 | 0.26 | 0.34 | 0.35 | 0.22 | 0.34 | | | | | | |
| % samples "very stable" | 17% | 81% | 47% | 63% | 60% | 38% | 51.0% | 22.4% | 9.2% | 15.9% | 12% | 15 |
| n | 24 | 27 | 30 | 27 | 30 | 34 | | | | | | |
| No vegetation cover | | | | | | | | | | | | |
| Average soil stability | 1.64 | 4.43 | 3.53 | 3.80 | 4.72 | 2.50 | 3.44 | 1.17 | 0.48 | 0.83 | 0.7 | 12 |
| SD | 1.25 | 2.06 | 2.12 | 1.79 | 1.74 | 1.78 | | | | | | |
| SE | 0.26 | 0.45 | 0.52 | 0.40 | 0.41 | 0.51 | | | | | | |
| % samples "very stable" | 4% | 48% | 35% | 25% | 56% | 17% | 30.7% | 19.3% | 7.9% | 13.6% | 10% | 16 |
| n | 24 | 21 | 17 | 20 | 18 | 12 | | | | | | |

↓
Decreasing erosion hazard

"n" = number of samples collected per plot.
Red denotes values below a management assessment point.

Table A5d. Soil substrate (% by class) and surface aggregate stability class (mean and SE) and proportion of samples in "very stable" (=6) category, by monitoring plot, 302 stratum, Tucson Mountain District, Saguaro NP, 2009–2010.

| Parameter | 302_V02 | Across-plot measures | | | | | |
|---|---------|----------------------|-----|-----|-------|-----|-----|
| | | AVG | STD | SE | Sdiff | MDC | n= |
| Substrate | | | | | | | |
| Bare soil (<2 mm) - no overhead cover | 6% | 6.0% | n/a | n/a | n/a | 5% | n/a |
| Bare soil (<2 mm) - under vegetation | 0% | 0.0% | n/a | n/a | n/a | 5% | n/a |
| Litter and duff (organic matter) | 38% | 38.3% | n/a | n/a | n/a | 5% | n/a |
| Light cyanobacteria | 0% | 0.0% | n/a | n/a | n/a | 5% | n/a |
| Dark cyanobacteria | 0% | 0.0% | n/a | n/a | n/a | 5% | n/a |
| Lichen | 0% | 0.0% | n/a | n/a | n/a | 5% | n/a |
| Moss | 16% | 16.3% | n/a | n/a | n/a | 5% | n/a |
| Plant base | 10% | 9.6% | n/a | n/a | n/a | 5% | n/a |
| Gravel (2–75 mm) | 17% | 16.7% | n/a | n/a | n/a | 5% | n/a |
| Rock (76–600 mm) | 12% | 12.1% | n/a | n/a | n/a | 5% | n/a |
| Lichen on rock | 0% | 0.4% | n/a | n/a | n/a | 5% | n/a |
| Bedrock | 1% | 1.3% | n/a | n/a | n/a | 5% | n/a |
| Surface Soil Aggregate Stability | | | | | | | |
| Under vegetation | | | | | | | |
| Average soil stability | 4.00 | 4.00 | n/a | n/a | n/a | 0.5 | n/a |
| SD | 2.26 | | | | | | |
| SE | 0.41 | | | | | | |
| % samples "very stable" | 50% | 50.0% | n/a | n/a | n/a | 5% | n/a |
| n | 30 | | | | | | |
| No vegetation cover | | | | | | | |
| Average soil stability | 3.33 | 3.33 | n/a | n/a | n/a | 0.6 | n/a |
| SD | 2.27 | | | | | | |
| SE | 0.72 | | | | | | |
| % samples "very stable" | 40% | 40.0% | n/a | n/a | n/a | 5% | n/a |
| n | 10 | | | | | | |

"n" = number of samples collected per plot.

Table A5e. Soil substrate (% by class) and surface aggregate stability class (mean and SE) and proportion of samples in "very stable" (=6) category, by monitoring plot, all strata, Tucson Mountain District, Saguaro NP, 2009–2010.

| | Parameter | AVG | STD | SE | Sdiff | MDC | n= |
|--------------------------------|---|-------|--------|-------|-------|-----|-------|
| ↓ Decreasing erosion hazard | Substrate | | | | | | |
| | Bare soil (<2 mm) - no overhead cover | 4.2% | 2.03% | 0.61% | 1.4% | 5% | 1 |
| | Bare soil (<2 mm) - under vegetation | 3.9% | 2.17% | 0.65% | 1.5% | 5% | 1 |
| | Litter and duff (organic matter) | 17.9% | 10.94% | 3.30% | 7.7% | 5% | 21 |
| | Light cyanobacteria | 3.4% | 5.09% | 1.53% | 3.6% | 5% | 5 |
| | Dark cyanobacteria | 0.2% | 0.51% | 0.15% | 0.4% | 5% | 1 |
| | Lichen | 0.2% | 0.39% | 0.12% | 0.3% | 5% | 1 |
| | Moss | 7.7% | 11.48% | 3.46% | 8.1% | 5% | 23 |
| | Plant base | 2.1% | 2.77% | 0.84% | 2.0% | 5% | 2 |
| | Gravel (2–75 mm) | 42.6% | 25.81% | 7.78% | 18.3% | 11% | 24 |
| | Rock (76–600 mm) | 12.7% | 10.70% | 3.23% | 7.6% | 5% | 20 |
| | Lichen on rock | 2.8% | 7.45% | 2.25% | 5.3% | 5% | 10 |
| | Bedrock | 2.4% | 3.53% | 1.06% | 2.5% | 5% | 3 |
| | Surface Soil Aggregate Stability | | | | | | |
| Under vegetation | | | | | | | |
| | Average soil stability | 4.42 | 0.64 | 0.19 | 0.45 | 0.3 | 20.00 |
| | SD | | | | | | |
| | SE | | | | | | |
| | % samples "very stable" | 40.5% | 23.37% | 7.05% | 16.5% | 10% | 24 |
| | n | | | | | | |
| No vegetation cover | | | | | | | |
| | Average soil stability | 3.35 | 0.93 | 0.28 | 0.66 | 0.4 | 24.00 |
| | SD | | | | | | |
| | SE | | | | | | |
| | % samples "very stable" | 24.3% | 19.06% | 5.75% | 13.5% | 8% | 25 |

"n" = number of samples collected per plot.

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