Monitoring of Special Status Plants in the Algodones Dunes, Imperial County, California Results of 2003 Pilot Sampling

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Executive Summary

A pilot monitoring program was initiated in spring 2003 in the Wilderness and Gecko management areas of the Algodones Dunes (also called Imperial Dunes), Imperial County, California. The special status plants, Peirson's milk-vetch, Algodones Dunes sunflower, and sand food, were the targets of the monitoring. Because Peirson's milk-vetch is Federally listed as threatened, its habitat was used to focus monitoring efforts for all three species.

Peirson's milk-vetch habitat was sampled by a total of 18 belt transects, 9 in each management area. Each transect was 25m wide. Lengths of transects varied depending on the extent of habitat crossed; lengths averaged 13.4 km in the Wilderness Management Area and 12.8 km in the Gecko Management Area. In addition to counting the total number of individual plants of each of the three species, counts were also made in other categories important to the life-history of each of the species (e.g., seedlings and flowering plants—see body of report for details).

The purpose of the 2003 pilot monitoring was to test the monitoring prescribed in the proposed Imperial Sand Dunes Recreation Area (ISDRA) Management Plan and to estimate the sample sizes that will be required to monitor Peirson's milk-vetch in each of the seven management areas[1] within the ISDRA. Pilot study results indicate that the methods proposed for the full monitoring program will work well, except that some modification will be necessary for the seedling category, at least for Algodones Dunes sunflower. A flush of seedlings of that species in 2003 required observers to count far too many individual plants. This problem will be solved by using a separate belt transect width (probably 2m) to count seedlings, while retaining the 25m width to count adults.

The pilot study also illustrated the need to complete the monitoring before it becomes too hot in the dunes for observers to safely walk the transects. This means that the full monitoring effort should be timed to be completed by the end of May of each year. This will require fielding many teams of observers at the same time.

[1] The proposed ISDRA Management Plan divides the Imperial Sand Dunes Recreation Area into eight management areas. At the time of this report the Management Plan had not yet been approved, so these management areas are still proposed. The monitoring prescribed in the proposed ISDRA Management Plan would monitor seven of the eight management areas; the eighth, Dune Buggy Flats, would not be monitored because it contains very little Peirson's milk-vetch habitat.

About 99% of Peirson's milk-vetch plants encountered during the 2003 monitoring were seedlings or young, nonflowering plants. This is in contrast to previous monitoring between 1998 and 2002, when almost all of the plants encountered during the same April-May time period were adult, flowering plants. A similar phenomenon was observed for Algodones Dunes sunflower. About 92% of all sunflower plants encountered during the April-May 2003 monitoring were seedlings. This contrasts with the tallies made during the 1998-2002 monitoring in which most of the plants were adults. Because of the very high percentage of seedlings observed for Peirson's milk-vetch and Algodones Dunes sunflower, spring 2003 must be considered something of an anomaly compared to the previous five springs. This fact may affect the validity of sample size estimations based on the 2003 data.

Introduction

The monitoring plan for the proposed Imperial Sand Dunes Recreation Area (ISDRA) Management Plan[2] calls for surveys to be conducted in seven management areas of the ISDRA in order to estimate the total population size of three special status plants: *Astragalus magdalenae* var. *peirsonii* (Peirson's milk-vetch, hereafter abbreviated as ASMAP); *Helianthus niveus* ssp. *tephrodes* (Algodones Dunes sunflower, hereafter abbreviated as HENIT); and *Pholisma sonorae* (sand food, hereafter abbreviated as PHSO). The sampling objectives section from the proposed plan reads as follows:

> Sampling Objectives: Although all 3 target plant species will be sampled, the following sampling objectives are based on ASMAP. It is anticipated that similar precisions will also be obtained for the other 2 species (Algodones Dunes sunflower and sandfood). There are two sampling objectives, one for the yearly estimates and one for change detection. For the yearly estimates, sampling will be designed to achieve estimates that are within 30% of the true total population size at the 95% confidence level for each of these management areas. For change detection, the sampling objective is to detect a 30% change between two average-to-above-average rainfall years with a statistical power of 90% and a false-change (Type I) error rate of 10%.

In order to evaluate the likelihood of meeting these sampling objectives, pilot sampling of two of the seven management areas was conducted in spring 2003: the Wilderness Management Area and the Gecko Management Area. The Wilderness Area has been closed to off-highway vehicle (OHV) use since 1972 and would remain closed under the prescriptions of the proposed ISDRA Management Plan. The area comprising the Gecko Management Area was open to OHV use until November 2000, at which time part of the area was closed to OHV use on an interim basis as part of a consent decree reached on a lawsuit. The consent decree requires that these interim closures remain in place until the new ISDRA Management Plan is approved. The proposed management plan would reopen the Gecko Management Area to OHV use.

In addition to evaluating the sampling objectives in the proposed monitoring plan, the pilot sampling was intended to also highlight any logistical issues associated with the monitoring. Although monitoring was conducted by BLM (with the help of other State and Federal agencies, the California Native Plant Society, and volunteers) between 1998 and 2002, that monitoring was substantially different from the monitoring proposed in the proposed ISDRA Management Plan. For one thing, that monitoring was directed at obtaining an index of abundance, not actual population estimates. In addition, the 1998-2002 monitoring consisted of running 34 transects due west to east across the Dunes. Finally, with only a few exceptions, only the 14 transects north of Highway 78 (in the Wilderness Area and in what is now called the Mammoth Wash Management Area to the north of the Wilderness Area) were walked by observers. The remaining 20 transects were surveyed using a dune buggy. In contrast, the proposed monitoring is directed at obtaining actual estimates of population size, the transects are to be oriented in a

[2] A final ISDRA Management Plan was released to the public in May 2003, along with a final environmental impact statement. However, the Record of Decision has not yet been signed. The word "proposed" is used here to indicate that the plan has not yet been approved.

NW to SE direction corresponding to the dune gradient, and all transects are to be walked. Thus, many more kilometers of dunes will have to be walked, and the staging of teams of observers will be much more difficult because the starting and ending points of each transect are in areas deep in the dunes (the 1998-2002 transects began at a road on the west side of the dunes and ended at a road on the east side of the dunes). For more information on the 1998-2002 monitoring see Willoughby (2000 and 2001).

Methods

The 1998-2002 monitoring results were used to identify ASMAP habitat within the Wilderness and Gecko management areas. Those results demonstrated that ASMAP occurs primarily in a relatively narrow band along what could be considered the central "spine" of the NW-SE trending dunes. Thus, there are areas along the west edge of the dunes that are not occupied by ASMAP and even wider areas along the east side of the dunes that are unoccupied. For efficiency in sampling, these unoccupied areas were not considered part of the statistical population to be sampled. Map 1 shows the areas within the Wilderness (2,591 hectares) and Gecko (3,710 hectares) management areas that were sampled for ASMAP. The distribution of HENIT closely parallels the distribution for ASMAP, so this sampling design likely also captures the lion's share of potential HENIT habitat. PHSO, however, has a wider distribution in the dunes than either ASMAP or HENIT, so this design does not capture all the PHSO habitat in the two management areas. The PHSO population estimates for each of the management areas should therefore be viewed as incomplete.

The 2003 pilot monitoring plan called for 10 transects to be positioned in each of the two management areas. Because of employee health concerns related to intense heat, only 9 transects were surveyed in each of the management areas. The transects were positioned using a restricted random design (Elzinga et al. 2001, pages 126-127). A baseline along the NW edge of each of the areas to be sampled was subdivided into 10 equal segments. A single transect was then to be run from a randomly determined starting point within each of these 10 segments. Because, for the reasons given above, only 9 transects were run in each management area, one of the segments in each management area was not sampled. For the purposes of this pilot study, the exclusion of this segment is not considered significant, as most of each of the areas was sampled.

Each transect was a 25m wide belt. A global positioning system (GPS) was used to find the starting point of each transect and to record data along each belt. Data were recorded in 25m segments along each belt, in order to allow comparison of each segment's plant data to OHV vehicle track cover that will be determined for each segment in geo-referenced aerial photography that will be collected once the full monitoring program is underway. The following information was collected for each species within each segment of the belt:

ASMAP: Total number of individual plants, number of nonflowering plants (seedlings), number of flowering plants, number of plants greater than 1 year old, number of plants with evidence of vehicle damage, number of plants with other damage.

HENIT: Total number of individual plants, number of flowering adults, number of nonflowering adults, number of seedlings, number of plants with evidence of vehicle damage, number of plants with other damage.

PHSO: Total number of inflorescences, number of living inflorescences, number of dead inflorescences.

Data were also collected for the psammophytic vegetation that is the habitat for the above three species. Line intercept transects, each 50m in length, were used to measure both the cover and density of perennial plants encountered at 1 km intervals along the left edge of each of the belt transects used for the special status plant monitoring. These line intercept transects were positioned using a systematic sample with a random start. The 25m segments used to sample the three special status plants were used to determine the starting point for the first vegetation transect along each belt transect. There are 40 such 25m segments in each 1 km of the belt transect. One of the first 39 segments was randomly selected (because the line intercept transect is 50m in length, use of the 40th segment would result in the 50m transect running past the 1 km point). Additional transects were then run at 1 km from the first one. For example, the random starting point in Belt Transect 1 in the Wilderness Management Area was the 75m mark (the beginning of segment 4) along the belt. Therefore, the first line intercept transect began at the 75m mark, the second began at the 1075m mark, the third at the 2075m mark, and so on until the last one at the 13075m mark.

The distance intercepted by each perennial plant along each 50m line was recorded by species, along with the width of each intercepted plant as measured by the longest width perpendicular to the line. This procedure allows estimation of both canopy cover and density of shrubs by species. Appendix 1 discusses how the line intercept procedure can be used to estimate density, as well as other attributes.

Appendix 2 shows the data sheets used to record data and the instructions that were provided to observers.

Map 2 shows the locations of the 10 transects in each of the two management areas sampled. Transects were numbered from 1-10 beginning on the west side of each management area. Transect number 2 in the Wilderness Management Area and transect number 3 in the Gecko Management Area were not sampled for the reasons given above.

Transects completely traversed each management area and were therefore of variable length. Following are the lengths of each of the transects surveyed:

Wilderness Management Area		Gecko Management Area	
Transect Number	Length (km)	Transect Number	Length (km)
1	13.93	1	15.23
3	14.17	2	15.19
4	14.29	4	15.12
5	14.33	5	14.96
6	14.35	6	14.92
7	14.41	7	13.03
8	14.50	8	12.30
9	14.51	9	8.96
10	14.62	10	5.75

On-the-ground sampling took place between March 31 and May 30, 2003. Following are the dates on which each of the transects were surveyed:

Wilderness Management Area		Gecko Management Area	
Transect Number	Dates Surveyed	Transect Number	Dates Surveyed
1	10 and 14 April	1	31 March 1 and 2 April
3	15 and 16 April	2	15, 16, 27, and 28 May
4	21, 22, 24, and 25 April	4	3, 4, and 7 April
5	21, 29, and 30 May	5	9, 15, and 16 May
6	8 and 14 May	6	5 and 6 May
7	6, 8, and 13 May	7	29 and 30 April
8	20, 21, and 23 May	8	1 April
9	10, 14, and 15 April	9	3, 7, and 8 April
10	8 and 9 April	10	22 and 23 April

Monitoring was conducted by personnel from the BLM El Centro Field Office under the direction of Chris Knauf. Personnel from other agencies also assisted with some of the transects. The following people took part in this effort: Bob Bower, Gary Diridoni, Erin Dreyfuss, Tyler Grant, Chris Knauf, Amy McGrann, Mike McGrann, Tom Sharkey, Jonathon Snapcook, Daniel Steward, Meredith Steward, Jason Tinant, Marc Trautz, Gary Wallace, and Gavin Wright.

Previous pilot sampling. The highly clumped nature of ASMAP makes the use of belt transects (long, narrow quadrats) mandatory in order to achieve reasonably precise estimates (Elzinga et al. 2001). Pilot sampling was conducted on ASMAP and HENIT in 2001 and on ASMAP, HENIT and PHSO in 2002 using belt transects run due west-east across the dunes (this pilot sampling was done in concert with the abundance class monitoring conducted between 1998-2002). The belts ranged from 5.8 km to 15.9 km long depending on the extent of the dunes crossed by each transect. In 2001 the number of plants of each species was recorded separately in 1m wide belts on each side of the transects, so that separate coefficients of variation could be calculated for both 1m and 2m wide belts. Coefficients of variation (CVs) were unacceptably high for both belt widths, and samples of 34 belts yielded imprecise estimates of population size (Table 1 shows the CVs and precisions for ASMAP for different belt widths). Accordingly, in 2002 pilot sampling was expanded to add belt widths of 5m and 10m. The 2002 sampling included PHSO in addition to ASMAP and HENIT. In 2002 the number of plants of each species was recorded separately in 1m, 2m, 5m, and 10m wide belts on one side of each of the transects, so that separate coefficients of variation could be calculated for belts of all 4 widths. As expected, CVs progressively decreased and precision progressively improved as the belt widths were increased, but even the 10m belt width still resulted in a rather high CV, and a sample of 34 belt transects resulted in a population estimate for ASMAP of ± 62%. These pilot data indicated that even wider belt widths should be used if practical to reduce the CV even further and minimize the number of sampling units that will be needed to achieve sampling objectives.

The 2001 and 2002 pilot data were collected using belts oriented with their long sides in a west to east direction (they were oriented in this direction because the pilot data were collected ancillary to a different monitoring study that began in 1998). Belt transects are most efficient when they are oriented to follow a gradient that is known to be related to the attribute being sampled. Both ASMAP and HENIT occur in bowls at the bottom of SE facing slipfaces and on the gentle NW-facing slopes that run SE from the bowls (Phillips et al. 2001 and 2002; personal observations). The two species gradually disappear as the NW-facing slopes approach sand ridges. Thus, the plant species are responding to the NW-SE gradient consisting of a repeating pattern of relatively gentle NW-facing slopes, ridges, slipfaces, and bowls. Belts, therefore, that are oriented in this same NW-SE direction should prove to be more efficient in terms of reducing sampling error than W to E belts. For this reason the 2003 pilot sampling oriented the belts in a NW-SE direction.

Table 1. ASMAP coefficients of variation (standard deviation divided by mean) and precisions expressed as 95% confidence intervals from a sample of 34 belt transects. CVs and precisions for the 1m belt width are the average of two samples in 2001 and one sample in 2002. Those for the 2m belt width are the average of one sample in 2001 and one sample in 2002.

Belt width	Coefficient of Variation	Precision (+/- percent of mean)
1 m	2.659	92.78%
2 m	2.320	80.94%
5 m	1.984	69.24%
10 m	1.769	61.73%

A belt width of 25m is likely the widest practical width for ASMAP. Although belt widths as wide as 25m are problematic for some species, particularly in dense vegetation, the size of ASMAP individuals, coupled with the sparse vegetation in the dunes, make belts this wide practical. The 2003 pilot sampling therefore used a 25m belt width.

Data Analysis

Population and density estimates for special status plants. Because the belt transects were of unequal lengths, and therefore had unequal area, a ratio estimator was used to estimate population size and variance in accordance with the recommendations of Stehman and Salzer (2000). The reader is referred to that paper for a discussion and example of how this procedure is employed. Workbooks were developed in Microsoft Excel to implement this procedure. Because the transects sampled 12% of the habitat area of the Wilderness Management Area and 8% of the habitat area in the Gecko Management Area, the finite population correction factor was applied to estimates of standard error, resulting in an narrowing of the 95% confidence intervals around the estimates.

No testing was performed to determine if differences between the two management areas were statistically significant, because such testing is not planned as part of the full monitoring program and was therefore not part of the pilot study.

Psammophytic vegetation. Cover was analyzed using the program SYSTAT, version 10.2 (SYSTAT 2002), using the 50m transects as the sampling units.

Density was analyzed using the procedure discussed in Appendix 1. A Microsoft Excel workbook was developed to implement this procedure based on the example given in Krebs (1999:137-138). Each belt transect was considered one sampling unit. All of the shrubs intercepted by each of the several 50m line intercepts along a belt were used in estimating the density for that belt.

Although not specifically planned for as part of the pilot study, the vegetation of two management areas were compared because habitat differences may be important in extrapolating sample size estimates to the management areas that were not sampled during the pilot study. Independent sample t tests (assuming unequal variances) were used to compare the Wilderness and Gecko estimates of shrub cover and density. A P value < 0.10 was determined to be statistically significant.

Results

Special Status Plant Monitoring

Following are the results of analysis for the three plants monitored. Results are given both in terms of estimates of population totals and estimates of densities in terms of number of plants/hectare. The population totals and confidence intervals are converted to densities by dividing the former by the total area sampled, 2,591 hectares for the Wilderness Management Area and 3,710 hectares for the Gecko Management Area.

ASMAP. Table 2 displays estimates of population totals for the Wilderness Management Area. Because transect number 1 in this data set fell largely outside of psammophytic scrub habitat (the habitat necessary for ASMAP), another analysis was run eliminating transect number 1 from the data set. Those results are given in Table 3. Table 4 shows population totals for the Gecko

Management Area. No analysis is provided for the number of plants exhibiting vehicle damage or damage from other sources. In the Wilderness Management Area only 3 plants on one transect showed signs of vehicle damage and only 13 plants over two transects showed signs of damage from other sources. In the Gecko Management Area only 3 plants covering two transects showed signs of vehicle damage and only 4 plants on one transect showed signs of damage from other sources.

Tables 5 and 6 display density estimates for the Wilderness Management Area (with transect 1 eliminated) and for the Gecko Management Area, respectively.

Table 2. Population estimates for ASMAP in the Wilderness Management Area from a sample of 9 belt transects.

Class	Estimate	95% Confidence Limits		Coefficient of Variation	Precision (+/- percent of mean)
		Lower	Upper		
Total population size	53,249	19,773	86,726	0.874	63%
Number of flowering plants	578	280	876	0.718	52%
Number of nonflowering plants	52,671	19,371	85,971	0.879	63%
Number of plants >1 year old	1,862	232	4,381	1.88	135%

Table 3. Population estimates for ASMAP in the Wilderness Management Area from a sample of 8 belt transects (transect number 1 removed from analysis).

Class	Estimate	95% Confidence Limits		Coefficient of Variation	Precision (+/- percent of mean)
		Lower	Upper		
Total population size	59,591	23,930	95,251	0.759	60%
Number of flowering plants	648	348	948	0.588	46%
Number of nonflowering plants	58,943	23,429	94,457	0.764	60%
Number of plants >1 year old	1,989	221	4,912	1.865	147%

Table 4. Population estimates for ASMAP in the Gecko Management Area from a sample of 9 belt transects.

Class	Estimate	95% Confidence Limits		Coefficient of Variation	Precision (+/- percent of mean)
		Lower	Upper		
Total population size	115,267	66,815	163,719	0.569	42%
Number of flowering plants	296	126	465	0.777	57%
Number of nonflowering plants	114,972	66,437	163,506	0.572	42%
Number of plants >1 year old	1,182	92	3,765	2.958	218%

Table 5. Densities in terms of total number of plants/hectare for ASMAP in the Wilderness Management Area from a sample of 8 belt transects.

Class	Density (Plants/Hectare)	95% Confidence Limits	
		Lower	Upper
All plants	23.00	9.24	36.76
Number of flowering plants	0.25	0.13	0.37
Number of nonflowering plants	22.75	9.04	36.46
Number of plants >1 year old	0.77	0.09	1.90

Table 6. Densities in terms of total number of plants/hectare for ASMAP in the Gecko Management Area from a sample of 9 belt transects.

Class	Density (Plants/Hectare)	95% Confidence Limits	
		Lower	Upper
All plants	31.07	18.01	44.13
Number of flowering plants	0.08	0.03	0.13
Number of nonflowering plants	30.99	17.91	44.07
Number of plants >1 year old	0.32	0.02	1.01

HENIT. Table 7 displays population totals for the Wilderness Management Area. Because transect number 1 in this data set fell largely outside of psammophytic scrub habitat (the habitat necessary for HENIT), another analysis was run eliminating transect number 1 from the data set. Those results are given in Table 8. Table 9 shows population totals for the Gecko Management Area. For the Wilderness Management Area no analysis is provided for the number of plants exhibiting vehicle damage or damage from other sources, because no plants exhibited vehicle damage and only 1 plant on one transect showed signs of damage from other sources. In the Gecko Management Area, no analysis is provided for the number of plants with signs of damage from other sources, as only 2 plants over two transects showed signs of such damage. However, a total of 86 plants over six transects showed signs of vehicle damage, so an analysis is provided for that category.

Tables 10-11 display density estimates for the Wilderness Management Area (with transect 1 eliminated) and for the Gecko Management Area, respectively.

Table 7. Population estimates for HENIT in the Wilderness Management Area from a sample of 9 belt transects.

Class	Estimate	95% Confidence Limits		Coefficient of Variation	Precision (+/- percent of mean)
		Lower	Upper		
Total population size	458,283	83,012	833,555	1.139	82%
Number of adults	13,599	1,694	30,063	1.683	121%
Number of seedlings	444,684	78,066	811,302	1.146	82%
Number of flowering adults	9,642	1,201	24,923	2.204	158%
Number of nonflowering adults	3,958	1,082	6,834	1.010	73%

Table 8. Population estimates for HENIT in the Wilderness Management Area from a sample of 8 belt transects (transect number 1 removed from analysis).

Class	Estimate	95% Confidence Limits		Coefficient of Variation	Precision (+/- percent of mean)
		Lower	Upper		
Total population size	513,710	98,472	928,947	1.026	81%
Number of adults	15,244	1,694	34,011	1.562	123%
Number of seedlings	498,465	92,494	904,437	1.033	81%
Number of flowering adults	10,808	1,201	28,404	2.066	163%
Number of nonflowering adults	4,436	1,304	7,569	0.896	71%

Table 9. Population estimates for HENIT in the Gecko Management Area from a sample of 9 belt transects.

Class	Estimate	95% Confidence Limits		Coefficient of Variation	Precision (+/- percent of mean)
		Lower	Upper		
Total population size	406,391	162,249	650,534	0.814	60%
Number of adults	70,834	5,511	223,111	2.912	215%
Number of seedlings	335,557	111,198	559,917	0.906	67%
Number of flowering adults	2,121	903	3,338	0.778	57%
Number of nonflowering adults	68,713	5,346	220,261	2.988	221%
Number of plants with vehicle damage	1,105	86	3,462	2.889	213%

Table 10. Densities in terms of total number of plants/hectare for HENIT in the Wilderness Management Area from a sample of 8 belt transects.

Class	Density (Plants/Hectare)	95% Confidence Limits	
		Lower	Upper
All plants	198.27	38.01	358.53
Number of adults	5.88	0.65	13.13
Number of seedlings	192.38	35.70	349.07
Number of flowering adults	4.17	0.46	10.96
Number of nonflowering adults	1.71	0.50	2.92

Table 11. Densities in terms of total number of plants/hectare for HENIT in the Gecko Management Area from a sample of 9 belt transects.

Class	Density (Plants/Hectare)	95% Confidence Limits	
		Lower	Upper
All plants	109.54	43.73	175.35
Number of adults	19.09	1.49	60.14
Number of seedlings	90.45	29.97	150.92
Number of flowering adults	0.57	0.24	0.90
Number of nonflowering adults	18.52	1.44	59.37
Number of plants with vehicle damage	0.30	0.02	0.93

PHSO. Table 12 displays population totals for the Wilderness Management Area. Because PHSO is not restricted to the psammophytic scrub habitat, no analysis was conducted with transect number 1 eliminated from the data set. Table 13 shows the population totals for the Gecko Management Area. Because PHSO is not restricted to the psammophytic scrub habitat, the estimates for each of the management areas is likely substantially lower than would be the case if the entire management areas (and not just the ASMAP habitat) had been sampled.

Tables 14 and 15 display density estimates for the Wilderness Management Area (with transect 1 eliminated) and for the Gecko Management Area, respectively.

Table 12. Population estimates for PHSO in the Wilderness Management Area from a sample of 9 belt transects.

Class	Estimate	95% Confidence Limits		Coefficient of Variation	Precision (+/- percent of mean)
		Lower	Upper		
Total population size (number of inflorescences)	34,440	17,990	50,890	0.664	48%
Number of live inflorescences	31,221	16,275	46,166	0.666	48%
Number of dead inflorescences	3,219	1,208	5,231	0.869	62%

Table 13. Population estimates for PHSO in the Gecko Management Area from a sample of 9 belt transects.

Class	Estimate	95% Confidence Limits		Coefficient of Variation	Precision (+/- percent of mean)
		Lower	Upper		
Total population size (number of inflorescences)	13,586	2,305	24,866	1.125	83%
Number of live inflorescences	12,249	1,800	22,698	1.156	85%
Number of dead inflorescences	1,324	137	2,511	1.215	90%

Table 14. Densities in terms of total number of plants/hectare for PHSO in the Wilderness Management Area from a sample of 9 belt transects.

Class	Density (Plants/Hectare)	95% Confidence Limits	
		Lower	Upper
Total population size (number of inflorescences)	13.29	6.94	19.64
Number of live inflorescences	12.05	6.28	17.82
Number of dead inflorescences	1.24	0.47	2.02

Table 15. Densities in terms of total number of plants/hectare for PHSO in the Gecko Management Area from a sample of 9 belt transects.

Class	Density (Plants/Hectare)	95% Confidence Limits	
		Lower	Upper
Total population size (number of inflorescences)	3.66	0.62	6.70
Number of live inflorescences	3.30	0.49	6.12
Number of dead inflorescences	0.36	0.04	0.68

Psammophytic Vegetation Monitoring

Cover estimates. Cover values from each of the 50m transects were used to derive a mean cover estimate for each management area. Tables 16 and 17 show all of the shrubs intercepted during vegetation sampling, along with mean cover, 95% confidence limits, and minimum and maximum transect values. Shrubs showing 0% cover in the table were intercepted but had cover values less than 0.01%. Shrubs are shown in descending order of cover for each management area, using the symbols recognized by the Plants Database (USDA, NRCS 2003). A key to the symbols is given in Appendix 3. Total cover is the additive cover of all shrubs.

Table 16. Shrub cover of the Wilderness Management Area from a sample of 129 line-intercept transects. Listed in order of decreasing cover.

Species	Mean Cover (%)	95% Confidence Limits (%)		Coefficient of Variation	Precision (+/- % of mean)
		Lower	Upper		
Total	3.61	2.87	4.36	1.188	21
ERDE9	1.98	1.45	2.51	1.534	27
LATR2	0.30	0.02	0.58	5.265	92
PAARG	0.29	0.09	0.49	3.933	69
EPTR	0.27	0.04	0.50	4.717	82
DICA4	0.22	0.04	0.39	4.498	78
TIPL2	0.18	0.06	0.31	4.006	70
HENIT	0.16	0.00	0.39	8.209	143
CRWI2	0.09	0.00	0.19	6.515	113
AMDU2	0.06	0.00	0.13	6.201	108
PETHT	0.04	0.00	0.08	8.510	148
PSEM	0.01	0.00	0.03	11.358	198
ASMAP	0.00	0.00	0.00	8.450	147

Table 17. Shrub cover of the Gecko Management Area from a sample of 113 line-intercept transects. Listed in order of decreasing cover.

Species	Mean Cover (%)	95% Confidence Limits (%)		Coefficient of Variation	Precision (+/- % of mean)
		Lower	Upper		
Total	1.41	0.85	1.97	2.134	40
ERDE9	0.81	0.36	1.25	2.941	55
CRWI2	0.32	0.17	0.48	2.593	113
TIPL2	0.17	0.00	0.41	7.874	70
EPTR	0.08	0.00	0.18	7.113	133
DICA4	0.02	0.00	0.04	5.284	98
PETHT	0.02	0.00	0.06	10.630	198
ASMAP	0.00	0.00	0.00	10.630	198
HENIT	0.00	0.00	0.00	10.630	198

As Tables 16 and 17 show, mean total shrub cover was greater in the Wilderness Management Area (3.61%) than in the Gecko Management Area (1.41%), a difference that was statistically significant ($P < 0.000$). Also, several shrubs intercepted in the Wilderness Management Area were not intercepted in the Gecko Management Area (PAARG, AMDU2, LATR2, and PSEM). Cover values for all but one of the shrubs common to both areas were higher in the Wilderness Management Area, though only the differences for ERDE9 ($P < 0.000$) and DICA4 ($P=0.025$)

were statistically significant. CRWI2 was the only shrub with higher cover in the Gecko Management Area, a difference that was statistically significant (P = 0.015).

Density estimates. Density estimates for the most abundant shrubs are given in Tables 18 and 19.

Table 18. Density estimates for the most abundant shrubs (number of plants/hectare) in the Wilderness Management Area from a sample of 9 belt transects. Listed in order of decreasing density (CRWI2 included here because of its abundance in the Gecko Management Area).

Species	Mean Density (# plants/ha)	95% Confidence Limits		Precision (+/- percent of mean)
		Lower	Upper	
All shrubs	295.0	66.1	523.9	78
ERDE9	200.6	0.0	405.9	102
DICA4	33.1	0.0	69.8	111
TIPL2	32.8	0.0	67.4	105
CRWI2	0.6	0.0	1.5	168

Table 19. Density estimates for the most abundant shrubs (number of plants/hectare) in the Gecko Management Area from a sample of 9 belt transects. Listed in order of decreasing density.

Species	Mean Density (# plants/ha)	95% Confidence Limits		Precision (+/- percent of mean)
		Lower	Upper	
All shrubs	44.6	13.1	76.1	71
TIPL2	19.3	0.0	41.6	116
ERDE9	9.2	0.0	19.4	111
CRWI2	9.0	0.0	18.1	101
DICA4	5.6	0.0	12.0	114

The mean density of all shrubs was significantly higher in the Wilderness Management Area than in the Gecko Management Area (P = 0.036). Except for CRWI2, the densities of the other major shrub species were also greater in the Wilderness Management Area than in the Gecko Management Area, though only the difference for ERDE9 was statistically significant (P = 0.064). The density of CRWI2 was significantly higher in the Gecko Management Area (P = 0.065).

ERDE9 was the most abundant shrub in the Wilderness Management Area, while TIPL2 was the most abundant shrub in the Gecko Management Area.

The reasons for the differences between the two management areas in overall perennial vegetation cover and shrub density cannot be determined from this study, but the differences likely result from one or a combination of both of the following: (1) larger and more active dunes in the Gecko Management Area, resulting in more bare sand and less vegetation cover than in the Wilderness Management Area, or (2) more vehicle damage to perennial plants in the Gecko Management Area. Assuming that the former is a principal reason, it seems likely that the other management areas south of Highway 78 will be more like the Gecko Management Area than the

Wilderness Management Area in terms of vegetation cover and density, at least within the area sampled for ASMAP and HENIT, because the dunes in these areas are higher and more active than in the Wilderness Management Area. It is also likely that the Mammoth Wash Area at the north end of the dunes is more like the Wilderness Management Area than it is like Gecko.

Discussion

The main purpose of the 2003 pilot sampling was to estimate the sample sizes that will be necessary for the full implementation of the proposed monitoring study and to identify potential logistical and statistical problems in order to correct these in the full implementation phase. Sample size calculations are not discussed here. I will discuss, however, some important differences between 2003 and the previous five years in terms of the numbers of adults versus seedling plants.

Seedlings versus adult plants. About 99% of ASMAP plants encountered during the 2003 monitoring were seedlings or young, nonflowering plants. This is in contrast to previous monitoring between 1998 and 2002, when almost all of the plants encountered during the same April-May time period were adult, flowering plants. Table 20 shows the number of seedlings (including young, non-flowering plants) and adult plants counted in the years 1998-2003.

Table 20. Comparison of numbers of ASMAP adults and seedlings between 1998 and 2003. Numbers for 1998-2002 are the numbers of plants tallied in the process of assigning abundance class values to 0.45 mile x 0.45 mile cells. Numbers for 2003 represent the number of plants counted within belt transects. The category seedlings includes young, nonflowering plants.

Year	Number of Adults	Number of seedlings	Total Number of Plants	Percent Seedlings
1998	5,013	51	5,064	1
1999	942	0	942	0
2000	86	0	0	0
2001	5,186	744	5,930	13
2002	2,143	154	2,297	7
2003	95	15,506	15,601	99

Note the marked difference between the percent of ASMAP seedlings counted in 2003 (99%) versus the other years. The only precipitation events during the 2002-2003 growing season occurred on September 10-11, 2002, and on February 13, February 25, and March 16, 2003. If the September 10-11 event triggered any germination of milk-vetch, few if any individuals of that cohort survived until the monitoring was conducted in April-May 2003. Most of the plants encountered during the April-May 2003 monitoring likely germinated with the February-March 2003 rainfall and did not have sufficient time to reach the flowering stage. Given the intense heat that characterized late spring 2003, it is likely that few if any of this cohort survived long enough to flower.

The next highest percent of ASMAP seedlings (13%) was in 2001, at the culmination of a growing season that experienced significant rainfall events in four months, October 2000 and January, February, and March 2001. The seedlings counted in 2001 likely came from a cohort that germinated in response to the February-March 2001 rains (the February rains began on February 26).

A similar phenomenon was observed for HENIT. Table 21 shows the number of seedlings and adult plants of this species that were counted in the years 1998-2003.

Table 21. Comparison of numbers of HENIT adults and seedlings between 1998 and 2003. Numbers for 1998-2002 are the numbers of plants tallied in the process of assigning abundance class values to 0.45 mile x 0.45 mile cells. Numbers for 2003 represent the number of plants counted within belt transects.

Year	Number of Adults	Number of seedlings	Total Number of Plants	Percent Seedlings
1998	5,003	848	5,851	14
1999	7,255	290	7,545	4
2000	4,725	9	4,734	0
2001	4,404	2,972	7,376	40
2002	7,194	1,024	8,218	12
2003	7,205	81,499	88,704	92

About 92% of all sunflower plants encountered during the April-May 2003 monitoring were seedlings. This contrasts with the tallies made during the 1998-2002 monitoring in which most of the plants were adults. Only in 2001 did seedlings comprise a substantial percentage (40%) of the sunflower plants counted. The 2000-2001 growing season experienced significant rainfall events in October 2000 and in January, February, and March 2001. The February-March 2001 rains likely resulted in the relatively large cohort of seedlings observed during the April-May monitoring 2001. But sunflower germination in response to the earlier rains and older plants surviving from previous growing seasons (sunflower plants persist for longer periods than milk-vetch plants; correlation is low between sunflower abundance and growing season precipitation—see Willoughby 2001) nevertheless kept the percentage of seedlings to less than half that of adult plants. It seems clear from the very large number of seedlings encountered in spring 2003 that something about the 2002-2003 growing season triggered a much higher amount of sunflower germination than occurred in the previous five growing seasons. Temperature at time of germination may have played a large role in this, but a determination of this is beyond the scope of this report.

Because of the very high percentage of seedlings observed for Peirson's milk-vetch and Algodones Dunes sunflower, spring 2003 must be considered something of an anomaly compared to the previous five springs. This fact may affect the validity of the sample size estimations based on the 2003 data. This is discussed in more detail below.

Safety concerns. Temperatures in spring 2003 were much hotter than in any of the springs between 1998 and 2002 during which previous sampling took place. By the final day of sampling on May 30, temperatures at eye level had reached 125 degrees F by 11:00 am, signaling to the project leader that the pilot study must come to an end. As previously stated, this is the reason two of the twenty planned transects were not surveyed.

A multi-layered check-in and check-out system was established in order to ensure employee safety. This included notification by email, cell phone, radio, a check-out board, and San Bernardino County dispatch. In addition, a safety person with a vehicle was standing by at all times near the location(s) at which observers were traversing the dunes. A rule was established that any of the observers could cancel a particular day's survey at any time if he/she began to feel the effects of heat. Observers also monitored each other for signs of heat-related effects.

Because of the heat, the length of the transects, and the difficulty discussed below, all but one of the transects required more than one day to complete. Seven required two days to complete, eight required three days to complete, and two required four days to complete.

This pilot study illustrates the need to complete the monitoring before it becomes too hot in the dunes for observers to safely walk the transects. This means that the full monitoring effort should be timed to be completed by the end of May of each year. This will require fielding many teams of observers at the same time.

Sampling design issues. A major reason for the time required to complete transects had nothing to do with safety. The late winter rains in mid to late February 2003 resulted in a significant germination of HENIT seedlings. Counting the large number of seedlings encountered in the 25m wide belt transects took considerable time. As an example of the magnitude of this effort, each belt transect in the Wilderness Management Area contained an average of 6,155 HENIT seedlings, with one transect containing 18,109 seedlings. Observers had to count a total of 55,392 seedlings in the nine wilderness transects. This is far too many plants to have to count. A solution is to use a narrower belt transect to estimate seedlings than is used to estimate adults. This can be done in conjunction with the sampling of each 25m wide belt by using, for example, only the first 2m of the belt to count HENIT seedlings but using the entire 25m wide belt to count HENIT adults. This procedure will be used in future springs in which there is a flush of HENIT seedlings.

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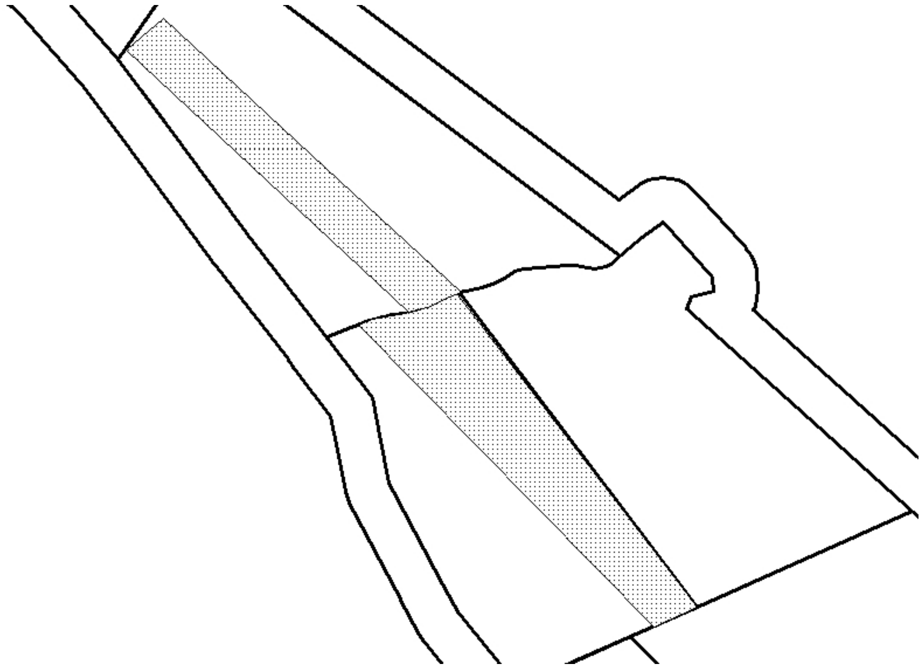
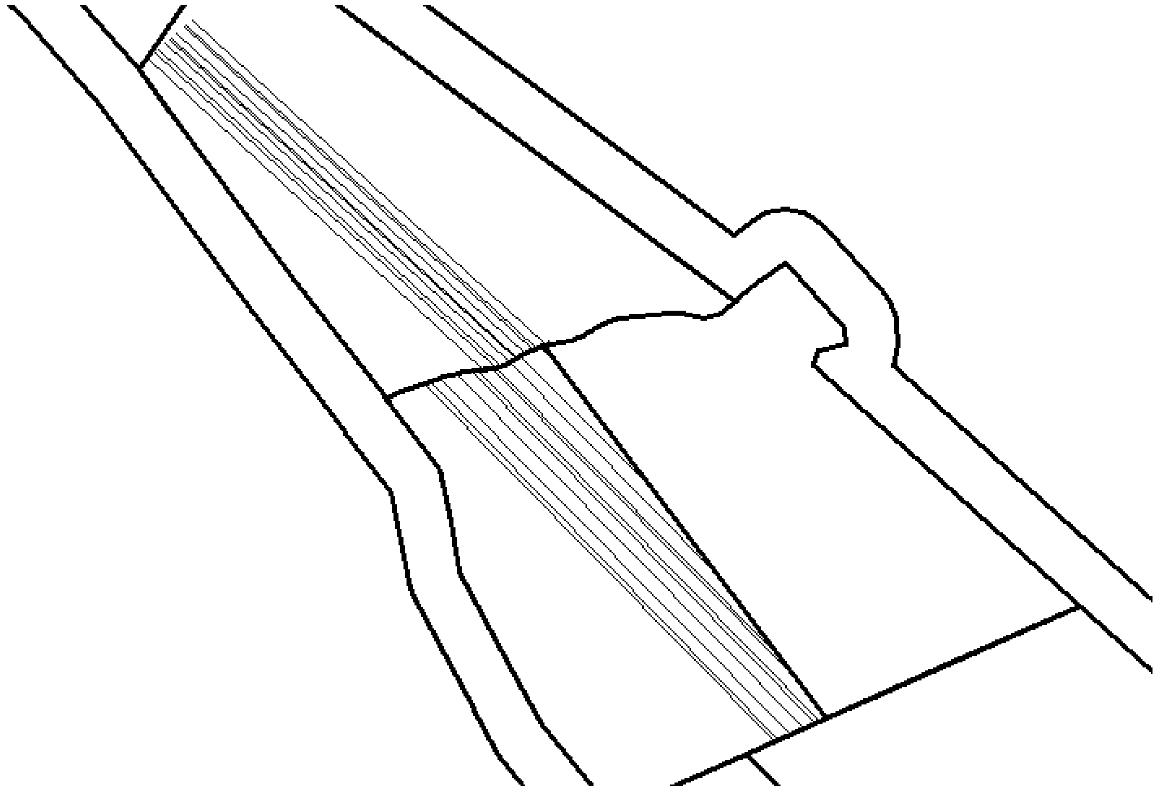


Map 1. Areas sampled within the Wilderness and Gecko management areas. The bold W-E line through the center of the map is State Highway 78. The sampled areas (shaded) correspond to the occupied habitat of ASMAP and HENIT based on data from BLM monitoring between 1998 and 2002. The area sampled was 2,591 hectares in the Wilderness Management Area and 3,710 hectares in the Gecko Management Area.



Map 2. Location of belt transects selected for sampling within the Wilderness and Gecko management areas. The bold W-E line through the center of the map is State Highway 78. Ten transects were selected in each management area (see text for selection methodology). These were numbered 1-10 beginning at the west (left) side of each management area. Because of logistical issues transect number 2 in the Wilderness Management Area and transect number 3 in the Gecko Management Area were not sampled.

Appendix 1. Using the Line-Intercept Method to Estimate Attributes other than Cover

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The use of the line-intercept method to estimate cover is well established in vegetation monitoring. One of the earliest papers on the use of the method to estimate cover is the one by Canfield (1941). Often not understood by vegetation ecologists is the fact the line-intercept method can also be used to estimate other attributes, including density, biomass, height, and utilization. In order to do this, however, measurements in addition to the length of line intercepted must be taken. For example, in order to estimate density, the width of each target plant intercepted must be measured in addition to the length of the intercept (width is measured perpendicular to the line intercept, but at the widest part of the plant; see Figure 1). Then, estimated density is calculated as:

$$\hat{D} = \frac{\sum_{j=1}^{m} \left(\frac{1}{w_j} \right)}{\sum_{i=1}^{n} L_i}$$

Where:

L_i	=	Length of transect i, i = 1, …, n
m	=	Number of distinct target plants intersected
w_j	=	Width of plant j relative to the transect

For further information on using line intercepts to estimate density and other attributes, please refer to the following papers. Lucas and Seber (1977), Eberhardt (1978), and McDonald (1980) show the calculations necessary to estimate density and its standard deviation using the line-intercept method. McDonald (1980) also demonstrates how to use the method to estimate other plant attributes such as biomass and height. Butler and McDonald (1983) show that systematic sampling with a random start yields unbiased estimates of cover and density and recommend using the formulas for simple random sampling to calculate standard deviations and standard errors. Krebs (1999:137-138) gives an example of using the method to estimate the density of willow.

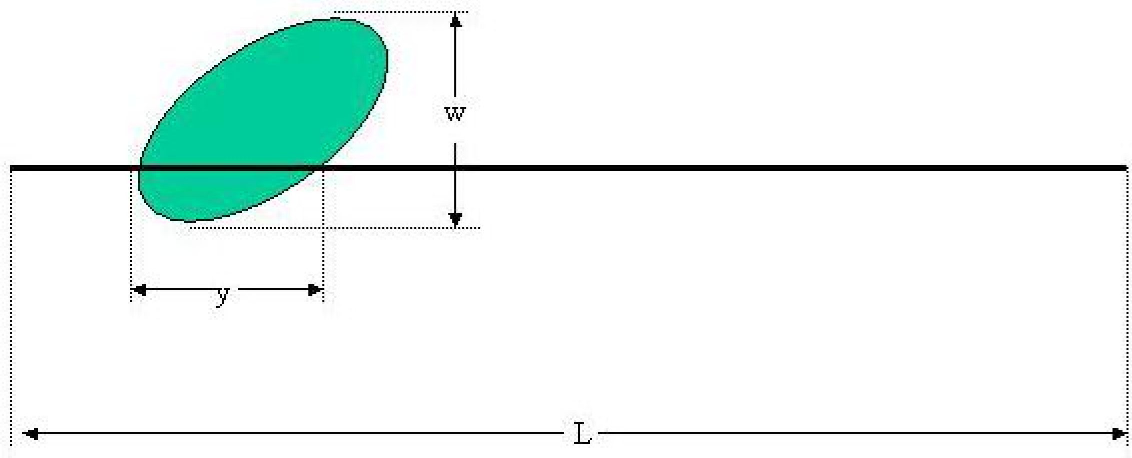

Figure 1. Transect (bold line) intercepting a shrub (oval). L is the length of the transect, y is the length of the transect intercepted by the shrub (the total length of all y's divided by the total length of all L's, multiplied by 100 yields an estimate of percent cover). The main purpose of this figure is to show how the width of the shrub (w) is measured in order to use w in the formula to calculate density.

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Appendix 2. Instructions and Data Sheets for Spring 2003 Special Status Plant and Psammophytic Vegetation Monitoring in the Algodones Dunes

Instructions for Monitoring and Filling Out Data Sheets

for Algodones Dunes Special Status Plant Monitoring
Spring 2003 Pilot Study

Monitoring in spring 2003 will consist of sampling at least two Management Areas of the Dunes to arrive at population estimates for *Astragalus magdalenae* var. *peirsonii* (Peirson's milk-vetch, abbreviated ASMAP), *Helianthus niveus* ssp. *teprodes* (Algodones Dunes sunflower, abbreviated HENIT), and *Pholisma sonorae* (sand food, abbreviated PHSO). Belt transects that are 25m wide will be run in a NW to SE direction completely through each management area.

Waypoints corresponding to the beginning and end of each transect will be entered into GPS units that will be used to navigate the transect. These waypoints will mark the beginning and end of the transect line, which will also be entered into the GPS units. These lines correspond to the left edge of each belt transect ("left" and "right" as used in these instructions correspond to the direction when the observer is walking from the beginning point in the NW to the end of the transect in the SE).

Data will be recorded by 25m segment along the belt. The person responsible for navigating using the GPS unit will walk the line entered into the GPS unit, being careful to stay on the line (transects are being treated as permanent, so it is vital to carefully navigate the actual line). This line will serve as the left edge of the 25m belt. Two other observers will then carefully examine the 25m belt as the transect is walked, one observer walking at the approximate right side of the belt transect and the other walking in the approximate middle of the belt. It is not necessary to actually measure the 25m width of the transect until plants of one or more of the target species are encountered (the observer on the right side of the belt should calibrate his/her pace using a meter tape and determine the number of paces corresponding to 25m; (s)he should then attempt to stay about that number of paces away from the left edge of the belt as the transect is surveyed).

If one of the target plants is sighted and is either obviously within the transect or near its edge, then actual measurement will be necessary. A 25m tape or rope will be used to determine the actual width of the belt beginning with the first encountered clump of plants. The navigator walking the left edge of the transect will be careful not to look down at the ground (to avoid seeing the plants and therefore biasing where the left side of the belt will be placed). The observer in the middle of the belt will then take the 0 end of the tape/rope and give it to the navigator to hold at his right hip. The 25m end will be held by the observer on the right. The two observers will then count the plants in the appropriate categories (see below) while traveling down the transect. Separate counts must be made in each 25m segment of the transect, so once counting begins, the navigator must carefully monitor when one segment ends and the next one begins so that counts are recorded in the appropriate segment. Segment starting points and segment numbers are to be written down on one of the data sheets (there are 3 data sheets, each corresponding to a target species) only when plants of that species are encountered (further information on this below).

Instructions on what to enter in each cell of the data sheet:

Management Area: Enter the name or code of the management area you are sampling. Management areas and codes are as follows:

Mammoth Wash (MW)
North Algodones Dunes Wilderness (WILD)
Gecko (GECK)
Glamis (GLAM)
Adaptive Management Area (AMA)
Ogilby (OGIL)
Buttercup (BUTTER)

NOTE: The management area *must* be entered on *every* data sheet.

Transect Number: Enter the number of the transect you are reading. Beginning and ending coordinates corresponding to each transect number will have already been given to you.

NOTE: The transect number *must* be entered on *every* data sheet.

Date: Enter the date sampling occurs. The date must be entered on every data sheet.

Observers: Enter full names of each of the observers that read this transect. Observers must be entered on the first sheet. Preferably at least initials of observers should be entered on the remaining sheets.

Transect starting coordinates: Enter the starting coordinates for the transect in decimal lat/long corresponding to datum NAD83. This must be entered only on the first page of the data sheet.

Transect ending coordinates: Enter the starting coordinates for the transect in decimal lat/long corresponding to datum NAD83. This must be entered only on the first page of the data sheet.

Transect segment: When target plants are encountered in a transect segment, enter the segment starting point (in meters) and the number of the segment. Do not enter either of these for segments in which no plants are encountered.

> **Segment Starting Point on Line:** Enter the starting point for the 25m segment of the belt in which the target plant is encountered. The segment starting point must be a multiple of 25m. For example, a target plant in encountered at the 388m point along the belt. The segment containing that plant then begins at the 375m point and continues until

the 400m point. All plants between those two points are recorded in a row of the data sheet corresponding to that segment. Plants encountered at the 401m point would be recorded on the next row, corresponding to the segment beginning at 400m point and ending at the 425m point.

Segment #: 25m segments are numbered consecutively from the beginning point of the transect. The segment # is determined by the following formula:

$$\text{Segment \#} = \left(\frac{\text{Segment Starting Point (m)}}{25 \text{ m}} \right) + 1$$

Thus, if the segment starting point is at the 625m point along the line, then the segment number is 725m/25m + 1 = 29 +1 = 30.

The following cell entries are species-specific.

ASMAP

Total # plants: This is the total number of ASMAP individuals counted in the 25m x 25m transect segment. It is the sum of the number of flowering individuals and nonflowering individuals. Note that it is *not* the sum of flowering + nonflowering + > 1 year old + w/OHV damage + w/other damage, because individuals in the last 3 categories will have been already counted as flowering or nonflowering. It is recommended that you first tally flowering and nonflowering individuals on the data sheet and then sum these to arrive at the total number of plants.

 # Flowering: This is the number of flowering ASMAP individuals counted in the 25m x 25m transect segment. You can tally individuals in the cell provided (or use the back of the sheet if there is insufficient room in the cell). You *must*, however, carefully total the tally and enter that total number of flowering plants in the cell.

 # Nonflowering: This is the number of nonflowering ASMAP individuals counted in the 25m x 25m transect segment. You can tally individuals in the cell provided (or use the back of the sheet if there is insufficient room in the cell). You *must*, however, carefully total the tally and enter that total number of nonflowering plants in the cell.

 # > 1 yr. old: This is the number of ASMAP individuals (whether flowering or nonflowering, though most would be flowering at this age) counted in the 25m x 25m segment that are more than 1 year old. Based on previous monitoring and study it is postulated that most ASMAP plants are likely less than one year old and that plants greater than one year old can be recognized by the presence of leaf/branch scars near the base of the plants (these are areas where leaves and/or branches occurred during earlier years). Look for these scars and report the number of plants containing these as greater than 1 year old.

 # w/OHV damage: This is the number of ASMAP individuals counted in the 25m x 25m segment that have apparently been damaged by OHV use (look for physical damage corresponding to what one would expect from OHV damage as well as for other evidence such as tire tracks through the area containing the damaged plant).

 # w/other damage: This is the number of ASMAP individuals counted in the 25m x 25m segment that have damage not attributable to OHVs. Insect damage is the principle type of damage that would be reported here.

HENIT

Total # plants: This is the total number of HENIT individuals counted in the 25m x 25m transect segment. It is the sum of the number of flowering adults + nonflowering adults + seedlings. Note that it is *not* the sum of flowering + nonflowering + seedlings + w/OHV damage + w/other damage, because individuals in the last 2 categories will have been already counted as flowering, nonflowering, or seedlings. It is recommended that you first tally flowering, nonflowering, and seedling individuals on the data sheet and then sum these to arrive at the total number of plants.

Because this species apparently spreads by branches that lay down in the sand and take root, it is difficult to actually determine individuals except through tedious excavation that is too time consuming and too damaging to the plants for this monitoring effort. Instead a stem will be considered an individual if its rooted portion is greater than 1m from the rooted portion of another stem.

 # Flowering Adults: This is the number of flowering HENIT adults (i.e., not seedlings) counted in the 25m x 25m transect segment. You can tally individuals in the cell provided (or use the back of the sheet if there is insufficient room in the cell). You *must*, however, carefully total the tally and enter that total number of flowering plants in the cell. See counting rule under discussion of total # individuals above. NOTE: If *any* part of the plant considered an individual is flowering than that plant would be recorded as flowering.

 # Nonflowering Adults: This is the number of nonflowering HENIT adults (i.e., not seedlings) counted in the 25m x 25m transect segment. You can tally individuals in the cell provided (or use the back of the sheet if there is insufficient room in the cell). You *must*, however, carefully total the tally and enter that total number of nonflowering adults in the cell. See counting rule under discussion of total # plants above. NOTE: If *any* part of the plant considered an individual is flowering than that plant would be recorded as flowering. Do not report seedlings here.

 # Seedlings: This is the number of plants that are obviously seedlings. Count all seedlings regardless of how close together they may be (i.e., the gap counting rule used for adults does not apply to seedlings).

 # w/OHV damage: This is the number of HENIT individuals counted in the 25m x 25m segment that have apparently been damaged by OHV use (look for physical damage corresponding to what one would expect from OHV damage as well as for other evidence such as tire tracks through the area containing the damaged plant).

 # w/other damage: This is the number of HENIT individuals counted in the 25m x 25m segment that have damage not attributable to OHVs. Insect damage is the principle type of damage that would be reported here.

PHSO

Total # inflorescences: This is the total number of PHSO inflorescences counted in the 25m x 25m transect segment. It is the sum of the number of living inflorescences and dead inflorescences. It is recommended that you first tally living and dead inflorescences on the data sheet and then sum these to arrive at the total number of plants.

 # Living inflorescences: This is the number of living PHSO inflorescences counted in the 25m x 25m transect segment. You can tally inflorescences in the cell provided (or use the back of the sheet if there is insufficient room in the cell). You *must*, however, carefully total the tally and enter that total number of living PHSO inflorescences in the cell.

 # Dead inflorescences: This is the number of dead PHSO inflorescences counted in the 25m x 25m transect segment. You can tally inflorescences in the cell provided (or use the back of the sheet if there is insufficient room in the cell). You *must*, however, carefully total the tally and enter that total number of dead PHSO inflorescences in the cell.

Astragalus magdalenae var. *peirsonii* (ASMAP) Monitoring

Management Area:	Date:	Observers:
Transect Number:	Transect starting coordinates (decimal lat/long NAD 83):	Transect ending coordinates (decimal lat/long NAD 83):
Notes:		

Transect Segment		**ASMAP Attributes Tally**					
Segment Starting Point on line (m)	**Seg-ment #**	**Total # Plants**	**# Flowering**	**# Nonflowering**	**# > 1 yr. old**	**# w/OHV damage**	**# w/other damage**

Helianthus niveus ssp. *tephrodes* (HENIT) Monitoring

Management Area:	Date:	Observers:

Transect Number:	Transect starting coordinates (decimal lat/long NAD 83):	Transect ending coordinates (decimal lat/long NAD 83):

Notes:

Transect Segment		HENIT Attributes Tally					
Segment Starting Point on line (m)	**Seg-ment #**	**Total # Plants**	**# Flowering Adults**	**# Nonflowering Adults**	**# Seedlings**	**# w/OHV damage**	**# w/ other damage**

Pholisma sonorae (PHSO) Monitoring

Management Area:	Date:	Observers:
Transect Number:	Transect starting coordinates (decimal lat/long NAD 83):	Transect ending coordinates (decimal lat/long NAD 83):
Notes:		

Transect Segment		**PHSO Attributes Tally**		
Segment Starting Point on Line (m)	**Segment #**	**Total # Inflorescences**	**# Living Inflorescences**	**# Dead Inflorescences**

Instructions for Monitoring and Filling Out Data Sheets
for Algodones Dunes Psammophytic Vegetation Monitoring
Spring 2003 Pilot Study

Monitoring of psammophytic vegetation in spring 2003 will consist of sampling in conjunction with special status plant monitoring that will occur in at least two Management Areas of the Dunes. Refer to the special status plant monitoring instructions for details on the layout of belt transects.

Line intercept transects, each 50m in length, will be used to measure both the cover and density of perennial plants encountered at 1 km intervals along the left edge of each of the belt transects used for the special status plant monitoring. The left edge of each belt transect is entered as a line in GPS and the beginning and ending points of each line is entered as a waypoint. Data on special status plants will be recorded in 25m segments of the belt. The beginning point of one of these segments will be used to start a 50m line intercept transect. There are 40 such 25m segments in each 1 km. A random point will be selected in the first 1 km of the belt transect by randomly selecting one of the first 39 segments (because the line intercept transect is 50m in length, use of the 40th segment would result in the 50m transect running past the 1 km point). Additional transects will then be run at 1 km intervals from the first one. So, for example, if the randomly selected segment is 24, then the first line intercept transect would start at the 575m mark, with additional transects starting at the beginning of segments 64 (1,575m mark), 104 (2,575m mark), and so on until the end of the belt transect is reached.

The 50m line intercept transect will be laid out using a 50m tape beginning at the point on the line corresponding to the beginning of the appropriate segment and continuing to the end of the 2nd segment. Along each line intercept transect, the distance intercepted by the line will be recorded by individual and by species. This will result in an estimate of cover for each species as well as an estimate for total vegetation cover. Additionally, the width of each plant of each intercepted will be measured by means of a meter stick or another, shorter tape measure placed perpendicular to the line intercept transect at the plant's widest point. See Attachment 1 for a diagram of where to measure each plant; this attachment also shows how density will be calculated from this data set.

Because few plants form completely closed canopies, an important decision in using the line intercept method is how to treat gaps in the canopy of a plant being measured. The line intercept method is practical only if most of these canopy gaps are ignored and the canopy treated as if it were complete. If, however, gaps are significant, they should be taken into account or the estimate of cover will be unacceptably biased too high. For our purposes here, it is suggested that gaps in excess of 10cm on the same plant be recorded. There are cells on the data form where gaps in excess of 10cm are to be reported. The detailed instructions below explain how to do this.

Instructions on what to enter in each cell of the data sheet:

Page Number: Because there will be several data sheets associated with each line intercept transect, it is critical you fill in page numbers. Fill in the page number as you monitor each transect. Once you've finished the line intercept transect go back and fill in the total number of pages in the data set for the line intercept transect.

Management Area: Enter the name or code of the management area you are sampling. Management areas and codes are as follows:

Mammoth Wash (MW)
North Algodones Dunes Wilderness (WILD)
Gecko (GECK)
Glamis (GLAM)
Adaptive Management Area (AMA)
Ogilby (OGIL)
Buttercup (BUTTER)

NOTE: The management area *must* be entered on *every* data sheet.

Date: Enter the date sampling occurs. The date must be entered on every data sheet.

Observers: Enter full names of each of the observers that read this transect. Observers must be entered on the first sheet. Preferably at least initials of observers should be entered on the remaining sheets.

Belt Transect Number: Enter the number of the belt transect that this line intercept is associated with. Belt transects are used to estimate the density of special status plants. Each belt transect has several line intercept transects associated with it.

NOTE: The belt transect number *must* be entered on *every* data sheet.

Line Intercept Transect Number: Enter the number of this line intercept transect. Numbering should be consecutive along each belt transect (i.e., the line intercept transect in the first km of the belt transect is 1, the line intercept transect in the 2nd km is 2, and so on).

NOTE: The line intercept transect number *must* be entered on *every* data sheet.

Belt Transect Segment Number for Line Intercept Transect Start: Enter the segment number along the belt transect at which this line intercept transect starts. (Each belt transect is divided into 25m segments for recording purposes. Say, for example, the first line intercept transect is to begin at segment number 29. You would enter "29" in this cell and begin the line intercept transect at the beginning of segment 29.) The segment number is to be entered on the first sheet on which a new line intercept transect begins.

Belt Transect Starting Point (m) for Line Intercept Transect: Enter the point in meters corresponding to the starting point of the belt transect segment at which the line intercept transect begins. Using the above example, where the first line intercept transect starts at the beginning of belt transect segment 29, you would enter "700m" in this cell. This is calculated using the following formula:

$$\text{Starting Point} = \left(\text{Segment Number x 25m}\right) - 25\text{m}$$

The starting point is to be entered on the first sheet on which a new line intercept transect begins.

Genus species/Code: Enter the full name of the genus, species, and—if applicable—subspecies or variety or choose from the species codes given in Attachment 2.

Plant No.: Enter the number of the individual being measured. Numbers should be consecutive from the beginning of the line intercept transect (the beginning point for all line intercept transects will be at the northwest ends of the transects). Because these data are being used to estimate density as well as cover, you must keep separate measurements for each individual of each species encountered.

Begin: Enter the point along the measuring tape where the individual plant of this species first intercepts the tape. You should record in meters to the second decimal place (e.g., 5.02m) or in centimeters (e.g., 502 cm).

End: Enter the point along the measuring tape where the same individual plant last intercepts the tape, regardless of whether there are any gaps in canopy cover. Record in meters to the second decimal place or in centimeters.

Tot. length: This is the total length of the tape intercepted by the individual plant without taking into account any gaps in cover. You calculate it by subtracting the begin point from the end point. Record either in meters to the second decimal place or in centimeters.

Gaps: Enter the total length of all gaps in canopy cover that exceeding 10cm each. Record either in meters to the second decimal place or in centimeters.

Adj. length: This is the total length of the tape intercepted by the individual plant minus the total length of all gaps in canopy cover that exceed 10cm each. You calculate it by subtracting the total length of all gaps (recorded in the cell above) from the total unadjusted length.

Width: Enter the width of the individual plant perpendicular to the tape at the plant's widest point (see the figure in Attachment 1 for a graphical representation of where the width should be measured). Record either in meters to the second decimal place or in centimeters.

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Management Area:		Date:	Observers:
Belt Transect Number:	Line Intercept Transect Number:	Belt Transect Segment Number for Line Intercept Transect Start:	Belt Transect Starting Point (m) for Line Intercept Transect:
Notes:			

Genus species/Code		Plant No.____	Plant No.____	Plant No.____	Plant No.____	Plant No.____
	Begin					
	End					
	Tot. length					
	Gaps					
	Adj. length					
	Width					
	Begin					
	End					
	Tot. length					
	Gaps					
	Adj. length					
	Width					
	Begin					
	End					
	Tot. length					
	Gaps					
	Adj. length					
	Width					

Appendix 3. Plant Symbols for the Shrubs Intercepted by the Psammophytic Vegetation Monitoring

Symbol	Scientific Name	Common Name
AMDU2	Ambrosia dumosa	burrobush
ASMAP	Astragalus magdalenae var. peirsonii	Peirson's milk-vetch
CRWI2	Croton wigginsii	Wiggins' croton
DICA4	Dicoria canescens	desert twinbugs
EPTR	Ephedra trifurca	longleaf jointfir
ERDE9	Eriogonum deserticola	Colorado Desert buckwheat
HENIT	Helianthus niveus ssp. tephrodes	Algodones Dunes sunflower
LATR2	Larrea tridentata	creosote bush
PAARG	Palafoxia arida var. gigantea	giant Spanish needle
PETHT	Petalonyx thurberi ssp. thurberi	Thurber's sandpaper plant
PHSO	Pholisma sonorae	sand food
PSEM	Psorothamnus emoryi	dyebush
TIPL2	Tiquilia plicata	fanleaf crinklemat