APPENDIX I

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
El Centro Resource Area
1661 South 4th Street
El Centro, California 92243-4561

02/06/03
1150
CA 670.32

TO: Pete Sorenson/Sandy Vissman
U.S Fish & Wildlife Service
6010 Hidden Valley Rd
Carlsbad CA 92009-4219

FROM: Greg Thomsen/Field Manager
Bureau of Land Management
1661 S. 4th st
El Centro CA 92243

Subject: Monitoring Plan/ISDRA-RAMP.

We have enclosed an additional copy of the most recent monitoring plan for the Imperial Sand Dunes Recreation Area Management Plan. Also enclosed is an email copy of the most recent changes in the project.

Greg Thomsen
Field Manager

Lynnette Elser

02/06/03 09:16 AM

To: smvissman@aol.com
cc:
Subject: Re: Dunes monitoring plan

Hi Sandy,

Attached is a copy of the monitoring plan. Let me know if it is not what you expected.

I looked at the changes since you were last updated and there are only two. One, we will have to do further environmental compliance when we actually get ready to do it. That is moving the location of the Ranger Station from Osborne Overlook to expanding at the current Cahuilla location. The other is the "Buffer Zone". We decided to go ahead and consult on the Buffer Zone in WECO. There are no changes to the on the ground management of this area from the WECO EA. The area will allow camping within 50 feet of the centerline of lizard MA routes and 300 feet from the centerline of other routes. The 2 no camping areas in the lizard MA remain. However we will extend the fee area to collect fees for the entire one mile area around ISDRA. We believe that folks camp in this area to avoid the fees. Hopefully charging fees for the area will move them back to ISDRA.

Thanks for all you work. Let me know if you need any other information. Thanks,

Lynnette

Christopher Knauf

Christopher Knauf

02/05/03 05:01 PM

To: John Willoughby/CASO/CA/BLM/DOI@BLM, Lynnette Elser/CASO/CA/BLM/DOI@BLM
cc:
Subject:

monitoring-appendix-10-22-02.d

Appendix 1

Monitoring/Study Plan

TABLE OF CONTENTS

Introduction

This appendix provides the methodology that will be used to monitor species and habitats of concern in the ISDRA. Through research, monitoring, and analysis of the monitoring data, BLM will determine the impacts to species and habitats of concern due to recreational use of the ISDRA, and use this information to make management changes, if necessary. Management of recreational use throughout the dunes, especially in the adaptive management area (AMA), will be evaluated periodically in light of the results of this research and monitoring and revised as needed. The monitoring information will be used to make annual changes in the number of permits that will be issued for use of the AMA and to determine whether and when the management plan for the ISDRA needs to be amended.

This monitoring/study plan is a dynamic document. Based on periodic reviews of the quality of the data collected and the usefulness of the data for making management decisions, it will be amended as necessary in order to ensure that the most important information is available to the manager for decision-making.

Special Status Plant Monitoring And Management

The Algodones Dunes support numerous dune-endemic plants. Of special interest in terms of conservation are species whose distribution is restricted to the Algodones Dunes or whose status indicates that special management is necessary to ensure the ongoing persistence of the species. Three dune-endemic plants will be the target species of an intensive monitoring effort in the Algodones Dunes:

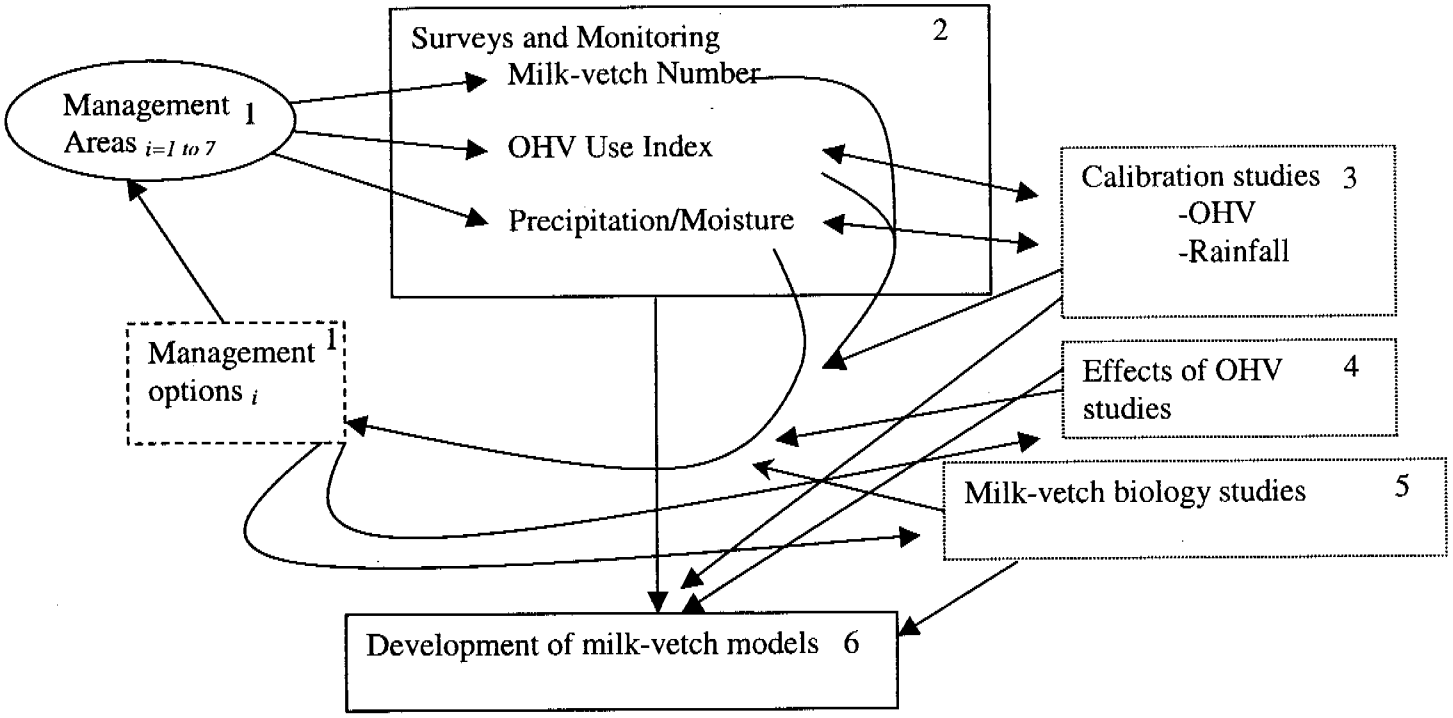
- Peirson's milk-vetch - *Astragalus magdalenae* var. *peirsonii* (ASMAP)
- Algodones Dunes sunflower - *Helianthus niveus* ssp. *tephrodes* (HENIT)
- Sand food - *Pholisma sonorae* (PHSO)

Peirson's milk-vetch will receive the highest level of attention, since this species was federally listed as threatened primarily due to threats posed by OHV activity in the Algodones Dunes. The monitoring and research pertaining to ASMAP will provide information that may be useful in managing all target plant and animal species in the dunes.

Peirson's Milk-vetch (ASMAP)

A flow chart of the general management scheme that will be used to adaptively manage the ISDRA to protect Peirson's milkvetch while providing the opportunity for recreation activities is provided as Figure 1.

Figure 1. Schematic of Peirson's milk-vetch monitoring and management plan.



Management Areas (Oval 1). The ISDRA will be managed in 9 units, 7 of which (listed below) support the target special status plants. This is the basis on which management will be applied. Each Management Area will be subject to an initial management option, which will be subject to change based on the status of milk-vetch in that unit and the results of studies. [1]

Management Area	Initial Management Option
Mammoth Wash	Open to OHV use
North Algodones Wilderness	Closed to OHV use
Gecko	Open
Glamis	Open
Adaptive Management Area (AMA)	Open to 525 riders/day
Ogilby	Open
Buttercup	Open

Surveys and Monitoring (Box 2). The monitoring surveys will illustrate the "state" of system variables including ASMAP abundance and distribution, ground moisture/ precipitation, and OHV use. These three state variables will be analyzed to test predictions based on management options that are currently being implemented and to

[1] Changes to the Adaptive Management Area will be made annually (after an initial period of sampling—see text), as necessary, through adjustments in the number of permits issued. If changes in OHV use and/or distribution are necessary in the other management areas, these would be made through the plan amendment process in consultation with the U.S. Fish and Wildlife Service.

provide information on which management option should be chosen in the future. These surveys will allow a statistical inference to be made to each management area. The initial prediction, based on BLM's understanding of current milk-vetch distribution and abundance, is that milk-vetch abundance and distribution in each management area will not change between years (that have comparable levels of rainfall above or equal to the long-term mean) given the proposed management options (see Box 1).

ASMAP Surveys

For the first four years of monitoring plan implementation, annual estimates of density and population size will be made in each of the seven management areas that support ASMAP. These estimates can also be combined into a single estimate for the entire ISDRA using the appropriate formula for stratified random sampling. Milk-vetch sampling will be conducted in the spring of each year, beginning at the time most ASMAP individuals are in flower. Based on monitoring between 1998 and 2002, this period begins around the last week of March.

Following the collection of four years of density estimates, the frequency of monitoring may be reduced to correspond to years in which the precipitation that occurs between July and November is sufficient to ensure precipitation levels that meet or exceed the long-term mean (see ground-moisture/precipitation section below) of precipitation levels between July and March. The reason for reducing the frequency of monitoring to good-rainfall years is that the abundance of ASMAP in any spring is highly correlated with the amount of rainfall in the growing season immediately preceding that spring (Willoughby 2001; Willoughby, unpublished data). Between wetter years, the milk-vetch population declines as plants die and are not replaced due to lack of germination. Monitoring during poor rainfall years could result in a lower encounter rate for ASMAP plants that is not reflective of the species' status. Monitoring during poor rainfall years could, however, provide information concerning the persistence of adult plants and the relative importance of these plants to seed bank contributions.

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%.

Sampling methodology. 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. 1998 and 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. 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 indicate 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.

One generally strives for a sampling design that results in a CV of less than 1.0, but because of the very scattered nature of its occurrences this may not be a practical goal for ASMAP. It is important to note, however, that these 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.

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 1 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.

Belt transects will be positioned using a restricted random design (Elzinga et al. 1998 and 2001) within each of the 7 management areas listed above.

Transects will be traversed in a NW to SE direction corresponding to the dune gradient discussed above. Baselines will be established at the NW edges of each of the management areas. An initial sample of 10 belt transects will be taken within each of the management areas. To accomplish this, the portion of the baseline that lies above the population to be sampled will be divided into 10 equal-sized segments. Within each of these segments, a single belt transect will be randomly positioned. The resulting 10 transects will extend the length (NW-SE) of the MA. The means and standard deviations derived for ASMAP will then be calculated and used to calculate the sample sizes required to achieve estimates of 30% of the mean. Additional transects will be added to the previous 10 to achieve this sampling objective. The additional transects will also be added using a restricted random design. This will be accomplished by dividing the same baseline used to position the initial 10 belts into the number of segments required to position the additional belts. Each additional belt will then be randomly positioned within each of the new segments, except that no additional belt will be placed in the same position on the baseline as one of the initial 10 transects (i.e., sampling will be without replacement).

Once established, the same transects will be sampled in succeeding years. This will be accomplished by the use of global positioning system (GPS) units. Many waypoints for each transect will be entered into the GPS units to ensure that observers walk the same transects each year.

Bias resulting from the edge effect associated with the use belt transects will be controlled by the following rule: plants with rooting parts touching the left (NE) side of the boundary of each belt transect will be counted in, while those touching the right (SW) side of the line will be counted out.

The following information will be collected for ASMAP: (1) total number of individuals observed; (2) number of flowering individuals; (3) number of non-flowering individuals; (4) number of individuals older than 1 year (this can be determined by the presence of basal leaf/branch scars); (5) number of individuals with apparent physical damage from OHVs; and (6) number of individuals with damage from other sources (e.g., insects). This information will be recorded in 25m segments along belts, which will allow comparison of information collected in 25m x 25m subplots with OHV use monitoring, discussed below. The GPS coordinates of the beginning of each 25m x 25m subplot containing plant species will also be recorded.

Analysis of Peirson's milk-vetch monitoring: The population estimates for ASMAP within each of the management areas will be graphed by year with error bars corresponding to 95% confidence intervals.

For each management area comparisons between densities in two average-to-above-average rainfall years will be made by means of paired *t* tests.

Ground Moisture/Precipitation Monitoring

Precipitation in the dunes will be measured by means of the two existing remote area weather stations (RAWS) and--once installed--by the additional five RAWS. Precipitation data for these stations will be collected for each month of the year.

Ground moisture will be monitored in each 25 m plot along each transect during each plant survey. This information will be compared to milk-vetch abundance and distribution as well as to weather data.

OHV Use Monitoring

OHV use levels will be estimated by means of aerial photography, taken yearly. Sixteen air photo transects were established throughout the dunes in 1998 in order to obtain a sample of the distribution and intensity of OHV use in the dunes through the measurement of vehicle tracks. The aerial photographs obtained from these transects are at a 1:7000 scale, allowing the detection of vehicle tracks. These transects were flown on Easter weekend 1998 and re-flown on Easter weekends in 1999, 2000, and 2001 (because of the ephemeral nature of vehicle tracks in sand, it was necessary to take the photographs during a weekend of relatively high vehicle use). The location of these air photo transects is shown in Willoughby 2000, along with the results of vehicle track frequency measurements for 1998.

The photographic information collected in 1999, 2000, and 2001 will be mapped and assessed for changes in use-levels and use-patterns.

In one year during the first four years following RAMP implementation, aerial photography will be obtained to achieve complete coverage of the dunes. This photography will be taken during three heavy OHV-use weekends in one recreation year (a recreation year begins in October of one calendar year and runs through Easter of the following calendar year). Photographs will be collected during Easter, Thanksgiving, and Presidents' Day weekends, which are historically high-use weekends. OHV use will be measured on these photographs using the methodology discussed below. Following analysis of these data, a determination will be made as to which high-use weekend provides the best index of OHV use or whether future aerial photography should be rotated between two or all three of these high-use weekends. Following the initial four-year period, aerial photography will be obtained for one high-use weekend per year.

Aerial photographs will be sampled by means of a grid of points to estimate the cover of vehicle tracks in the dunes. The size of the grid and number of points per transect will be determined based on pilot sampling to meet the sampling objective described below.

Future aerial photographs will be registered so that sampling grids can be placed in the same area in each year.

The transects and 25 m segments used during plant monitoring (described above) will be overlaid on aerial photographs to allow comparison of OHV-use levels and plant abundance and condition.

Based on the above analyses, the calibration study (see Box 3, described below) and general assessment of the photographs, aerial photographs will be used to produce GIS maps depicting areas of the dunes subject to high, medium, and low levels of use. These maps will be compared over time to allow assessment of changes in use intensity or use patterns over time.

Sampling Objective: Sampling will be designed to achieve yearly estimates of OHV track cover that are within 30% (relative) of the true OHV track cover at the 95% confidence level within each of the 9 management areas. Sampling will be designed to allow mapping and quantification of "high," "medium," and "low" use areas within each management area. A methodology for determining high, medium, and low use areas will be developed in coordination with the FWS. It is unlikely this sampling objective can be met for the wilderness area since the OHV track cover there will likely be extremely low. This sampling objective may be modified based on pilot sampling.

Calibration Studies: OHV Use and Rainfall (Box 3):

Since we are not able to estimate OHV use or rainfall directly for the whole dune area, we must rely on indices: the number of tracks from aerial photos and a measurement of ground moisture in discrete areas throughout the dunes. To understand what these indices mean in terms of true OHV use, calibration studies will be performed. For the OHV index, a known number of OHV-hours will be run in a replicated sample of un-tracked areas. The area will then be aerially photographed to calibrate the track counts with a known number of OHV-hours. This study may be conducted concurrently with the experimental study on OHV Effects (below) to facilitate both studies. Using this methodology, low, medium, and high-use areas will be defined in coordination with FWS. Techniques for calibration of rainfall with ground moisture levels throughout the dunes have not been developed; however, ground-moisture levels will be measured during surveys and the potential for calibration studies be evaluated over time.

The Effects of OHV Use on Peirson's Milkvetch: Inferential and Experimental Studies.

Correlative Study within the AMA

The densities of ASMAP, HENIT, and PHSO (number of plants/hectare) will be estimated for the entire AMA, for a 1 km^2 control area within the AMA, and for a 1 km^2 treatment area within the AMA in each of the three years following implementation of the RAMP. The treatment and control areas will be selected subjectively, subject to the

following considerations. The treatment area will be selected to function in a manner similar to the key area concept in rangeland management. As defined by the Society for Range Management (1998), a key area is:

A relatively small portion or a pasture of management unit is selected because of its location, use or grazing value as a monitoring point for grazing use. It is assumed that key areas, if properly selected, will reflect the overall acceptability of current grazing management over the pasture or unit as a whole.

Holechek (1988) and Holechek et al. (1998) point out that the key area concept has been highly useful to managers in evaluating the effects of grazing on rangeland vegetation. It is in wide use and is an accepted practice on Bureau of Land Management, Forest Service, and private rangelands (Habich et al. 1996). The concept should apply equally well to the evaluation of the effects of OHV use on ASMAP, HENIT, and PHSO. Just as for key areas in rangeland management, the treatment area will be selected to best reflect the effects of OHV use in the entire AMA. The control area will be selected to be as similar as possible in terms of habitat characteristics and weather to the treatment area.

The control and treatment areas will be rectangular in shape, with the long side of the rectangles oriented along the NW-SE dune gradient (discussed above under yearly monitoring for ASMAP, HENIT, and PHSO. The treatment and control areas will be 200m x 5000m in size and shape. An area 220m x 5020m in size, encompassing the control area with 10m added to each side of the rectangle to eliminate edge effect, will be signed closed and patrolled on a regular basis by law enforcement personnel. The treatment area will remain open to OHV use. The NW-SE orientation will incorporate more potential ASMAP, HENIT, and PHSO habitat within the control and treatment areas than would other orientations. Belt transects will also be used within the 1 km^2 AMA treatment and control areas, but an attempt will be made to completely census the treatment and control areas at least for ASMAP and HENIT. This would be accomplished by counting all plants of these species in contiguous 25m wide belts. If practical, PHSO will also be completely censused. Monitoring in the first year following implementation of the RAMP will determine whether complete censuses are practical.

Estimates for the treatment and control areas will be compared for each year. Comparisons will also be made between the responses of ASMAP, HENIT, and PHSO in the AMA as a whole and in the treatment area. These comparisons will be used to determine if the treatment area is adequately reflecting the effects of use in the AMA. If not, then a new treatment area will be selected or another treatment area added.

An attempt will be made to conduct actual censuses of the three species in the 1 km^2 control and treatment areas of the AMA. If this proves to be practical, then there will be no sampling error associated with the population sizes measured for these two areas. If this is not practical, sampling will be designed to achieve yearly estimates that are within 20% of the true total population size at the 95% confidence level for each area. The objective for change detection will be 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%. The use of the control and treatment areas within the AMA is discussed further under a separate heading, below.

Comparative Evaluation Between Milk-vetch Surveys and OHV-Use Surveys

As described in the ASMAP survey section (Box 2) 25m x 25m subplots will be established along milk-vetch survey belt transects. These subplots will subsequently be identified on aerial photographs developed for OHV monitoring. Milk-vetch abundance will be compared to OHV use levels.

The correlative studies described above allow inferences to be made regarding effects of OHVs on ASMAP. In addition to the correlative studies described above, a manipulative study is necessary to quantify the effects of OHV use on the reproductive capability and persistence of milk-vetch plants.

Experimental Study 1

Experiment number 1 will conducted during on two separate occasions: (1) in the spring of a year that experiences rainfall at or above the long-term mean, and (2) in the spring of a year that experiences rainfall below the long-term mean. The experiment will be conducted twice under different conditions to ascertain whether the effects of OHV use are different under different weather regimes. At least eight 200 m x 200 m plots will be selected and sub-divided into four 100 m x 100 m treatment plots. Four treatments (no, low, medium, and high OHV use) will be applied, with 8 replications for each treatment.

The definition of use categories will come from the OHV correlative study (described under Box 3) to make sure these are relevant treatment levels. Each plot will be censused for milk-vetch, before and after treatment is applied, and two months following treatment. During the census, the following variables will be measured: (1) the number of ASMAP individuals and ratio of seedlings to adults and (2) the number of plants with evidence of vehicle damage.

Analysis of data:

The null hypothesis is that there will be is no treatment effect. The alternative hypothesis is that there will be an ordered treatment effect.

A randomized complete block design will be used, with eight 200m x 200m plots, each sub-divided into four 100 m x 100 m sub-plots placed in different areas of the dunes. The reason for blocking is to remove spatial variability between blocks from the analysis.

Analysis will be on the before-after differences in the three variables (number of ASMAP individuals, ratio of seedlings: adults, and number of ASMAP plants with evidence of vehicle damage). Results will be displayed graphically showing mean difference by treatment with error bars corresponding to 90% confidence intervals. Effect sizes will be

measured and evaluated for a difference. Each variable will also be analyzed using an analysis of variance (ANOVA) that accounts for the effects of blocking. The experiment-wise Type I error rate will be set at 0.10. A *P* value from the ANOVA less than 0.10 would also indicate that there is a treatment effect. Post hoc tests will then be conducted to determine which pairs of treatments differ. These post hoc tests will control for the experiment-wise error rate.

Experimental Study 2

The second experimental study will quantify the impact on individual plants from being run over by a vehicle. The study will follow the general guidelines of a previous study conducted by Pavlik (1979) but will be conducted with a larger sample size.

Milkvetch Biological Studies (Box 5):

Additional biological information regarding the life-history of ASMAP is necessary to model the population, predict the population response to management options, and effectively manage the population. Information that is necessary to determine the effect of management options on this species include studies that address the questions listed below. These studies will be conducted by BLM, other Federal or State agencies, non-governmental organizations, or universities as funding is secured. These studies will address the following questions:

- What are the relative contributions of adult and seedling milk-vetch plants to the seedbank?
- Are seeds produced by milk-vetch seedlings viable?
- How much ground moisture is required to stimulate germination of milk-vetch seeds?
- How long do milk-vetch seeds remain viable?
- For how many years do adult milk-vetch plants remain reproductive?

Development of Milk-vetch Models (Box 6):

Our current understanding leads us to believe that two key variables, rainfall (moisture) and OHV use contribute to ASMAP dynamics in the Algodones Dunes. The information obtained from the surveys and studies listed above will be used to evaluate several models of ASMAP dynamics as they pertain to these variables. The area occupied by ASMAP may increase or decrease in response to OHV use, precipitation, or a combination of these factors. Each model will predict the impact of an action, which will result in some expected return in terms of the objective. Initially, each model will be given equal weight. Over time, each model of ASMAP dynamics will receive different weight based on monitoring and study results.

Management Options (Box 1):

The initial management option for the RAMP will be unlimited OHV use in 5 Management Areas, continued closure of the North Algodones Dunes Wilderness to OHVs, and 525 vehicles per day permitted use in the AMA. This management option will be assessed by studies and monitoring of milk-vetch populations to better understand the dynamics between moisture (precipitation), varying levels of OHV use, and milk-vetch reproduction, numbers, and distribution. In the future, management of each of these Management Areas may change in response to identified changes in the milk-vetch status in each unit and information gained from the aforementioned studies. Possible management options include those based on a permit system that would allow a specified level of use (high, medium, low, no use), temporally based closures or limitations (open during some months or years, closed in others), recognition and management of subunits within a management area, and/or increased education and outreach to OHV users to avoid certain areas. Most of these changes to management areas other than the Adaptive Management Area, discussed below, would require an amendment to the ISDRA Plan.

Adaptive Management

Adjusting the number of permits in the Adaptive Management Area:

No change in the number of riders permitted to use the AMA will be made until 3 years of monitoring and research data have been collected and analyzed. It is anticipated that differences in density of 30% percent between a baseline year and a subsequent year with comparable rainfall would be both detectable and biologically significant. If this level of change in milk-vetch abundance, distribution, or density occurs within the AMA, the BLM may adjust the management option in this Management Area. If a decline of this magnitude is observed, BLM may adjust management to a management option that provides increased protection for ASMAP. If an increase of this magnitude is observed, BLM may adjust management to a management option that allows increased recreational use of the area. No change in the number of riders permitted to use the AMA will be made until 3 years of monitoring and research data have been collected and analyzed. Several sources of information will then be used to determine if and when to adjust the number of OHV permits within the AMA: (1) comparison of the densities of ASMAP, HENIT, and PHSO in the control and treatment areas (correlative study within the AMA); (2) between-year comparison of the use patterns and use levels within the AMA; and (3) results of OHV impact studies described above.

Adaptive Management in other Management Areas:

Monitoring and studies will be conducted during the first four years of ISDRA Plan implementation in accordance with the Implementation Schedule below. After this four-year period, BLM will reinitiate Endangered Species Act (ESA) Section 7 consultation with the U.S. Fish and Wildlife Service so that scientific information collected as part of this monitoring/study plan can be fully integrated into the ESA Section 7a(2) analysis for this action. This consultation will also allow revision of the interim threshold, identified

below, if sufficient information has been obtained and identification of the adaptive management strategy to be used if milk-vetch populations decline below threshold levels.

Interim threshold: If the population of Peirson's milk-vetch in any of the management areas declines by more than 50% in two years of average to above-average growing season precipitation, BLM will re-initiate Section 7 consultation with FWS.

If BLM is unable to conduct monitoring and studies scheduled during the first four springs of RAMP implementation, BLM will re-initiate consultation with FWS.

Peirson's Milk-Vetch Monitoring/Study Implementation Schedule and Cost

	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
Precipitation monitoring (installation of weather stations and development of data base)		X $125,000			
ASMAP Monitoring Surveys*	X $140,000	X $140,000	X $140,000	X $140,000	* $140,000?
Dune-wide aerial survey (OHV use-patterns) and analysis (including mapping)			X $186,000		X $62,000
OHV Use Calibration Study (cost included with Experimental Study 1)		X			
Experimental Study 1 (OHV Use) **		X $30,000			** $30,000
Experimental Study 2 (OHV Use)				X $15,000	
AMA correlation study (OHV Use)	X $10,000	X $10,000	X $10,000	X $10,000	X $10,000
Survey/aerial photography comparison (OHV Use vs. Milk-vetch Abundance in 25m Sub-Plots			X $10,000	X $10,000	X $10,000
Compilation and mapping of 1999, 2000, 2001 OHV use data	X $10,000				
Development of Milk-vetch Models					X $20,000
Coordination with FWS Regarding Threshold Adjustment				X	
Estimated Cost for Fiscal Year	$160,000	$305,000	$346,000	$175,000	$102,000 or $242,000

* After the first three years, dune-wide ASMAP surveys will be conducted during "wet" years, likely every 4-5 years.

** The "dry year" repeat of Experimental Study 1 will be conducted in the first dry year after 2006.

Note: There is flexibility over which studies are funded during which fiscal years. The table above assumes that Experimental Study 1 will be conducted in FY 2004, that dune-wide aerial surveys will be flown during Thanksgiving weekend, Presidents' Day weekend, and Easter weekend of 2004-2005, and that Experimental Study 2 will be conducted in FY 2006. Other combinations are possible depending on funding availability for particular fiscal years.

Algodones Dunes Sunflower (HENIT)

Algodones Dunes Sunflower will be monitored in conjunction with Peirson's milk-vetch (ASMAP). Estimates of population size and the other parameters listed under the description of ASMAP surveys will also be made for HENIT using the same methodology described for ASMAP, including a belt transect width of 25m, except that different stage classes than those employed for ASMAP will likely be necessary due to the different morphology of HENIT. The OHV use monitoring described under the ASMAP section of this monitoring/study plan will also be used to determine correlations between levels of OHV use and abundance of HENIT. Experimental studies 1 and 2 described under the ASMAP section are primarily directed toward determining the effects of OHV use on ASMAP, but to the extent HENIT can be included in these studies it will be. In other words, the same measurements performed on ASMAP will also be performed on those HENIT individuals present in the ASMAP study plots. It may not be possible, however, to locate these study plots in a manner that incorporates sufficient numbers of both species to achieve similar levels of statistical confidence in the results for both species. These studies will be designed with the primary objective of determining the effects of OHV use on ASMAP (see study objectives in the ASMAP section), with the result that statistical confidence in the results for HENIT may be lower (perhaps much lower) than those for ASMAP.

Biological studies of HENIT would also yield valuable insight into the ecology of this species and BLM will work with universities, other agencies, and non-governmental organizations to encourage the funding and implementation of these.

Sand Food (PHSO)

Sand food will also be monitored in conjunction with Peirson's milk-vetch (ASMAP). Estimates of population size will be made for PHSO using the same methodology described for ASMAP, except that a narrower belt width will likely be necessary for PHSO owing to its more cryptic nature (it is anticipated that a belt width of 5m or 10m will be used for this species) and the identification of stage classes is not possible for this species (the counting unit is an inflorescence; the rest of the plant is hidden below the surface of the sand). The OHV use monitoring described under the ASMAP section of this monitoring/study plan will also be used to determine correlations between levels of OHV use and abundance of PHSO. Experimental studies 1 and 2 described in the ASMAP section will not be applied to PHSO because—for the most part--the latter species does not occupy the same areas of the dunes as the former.

Biological studies of PHSO would also yield valuable insight into the ecology of this species and BLM will work with universities, other agencies, and non-governmental organizations to encourage the funding and implementation of these.

PSAMMOPHYTIC VEGETATION

Both the cover and density of perennial plants will be estimated annually by means of line intercept transects run perpendicular to each of the belt transects described above at systematic intervals along each belt. A line intercept transect length of 50m will be used during pilot sampling; this length is subject to change depending on how well a transect of this length intercepts the variety of perennial plants present at each sampling location. These transects will be positioned systematically with a random start at 1 km points along each of the belt transects. Along each transect, the distance intercepted by the line will be recorded 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 species intercepted will be measured by means of a meter stick or other measuring device placed perpendicular to the line intercept transect at the plant's widest point. These widths will be used to estimate the density of each perennial plant, using methods described in Lucas and Seber (1977).

Sampling Objective: Sampling will be designed to achieve yearly estimates of cover that are within 50% (relative) of the true vegetation cover at the 95% confidence level within each of the 5 sampling areas. This sampling objective may be modified based on pilot sampling.

Analysis: Changes in total vegetation cover and the cover of at least the most dominant species will be analyzed in a manner analogous to that described for special status species, above.

DESERT MICROPHYLL WOODLAND VEGETATION

Monitoring of Desert Microphyll Woodland vegetation will be conducted annually, but monitoring of specific areas will be done on a five-year rotation using the protocol attached at the end of this appendix.

BIRD POPULATIONS IN MICROPHYLL WOODLAND

Monitoring of bird populations in microphyll woodland will be conducted in accordance with the protocol attached at the end of this appendix.

COLORADO DESERT FRINGED-TOED LIZARD

In 2001, 50 survey transects were completed for spring and fall in order to estimate the density of Colorado Desert fringe toed lizards (*Uma notata*) in a comparison of open and closed areas in terms of OHV use. The Algodones Dunes Wilderness Area was used as a control, while the open area to the south was used as a treatment. Using the grid established by the WESTEC Study of 1977 (WESTEC 1977), 0.45 mile square cells on

the grid were selected using simple random sampling after the elimination of habitat not entirely consistent with *Uma notata,* i.e., microphyll woodland, creosote bush scrub, and any cells within 0.45 miles of a road (Gecko Road and State Highway 78).

The first 60 Cells were then numbered (south to north in closed area, north to south in open area) in a snaking pattern before simple random sampling was applied. Transects were 0.45 mile long and 10m wide belts. Surveyors were evenly spaced, and navigated the transects using Garmin III global positioning system units on NAD 83 Map Datum from west to east using the northwest to northeast grid lines. Transects were alternated from open to closed areas in order to avoid weather bias, and were also completed when surface temperatures were at or between 35-44 degrees Celsius. Transects were not completed if (1) OHV activity was observed on the transect or (2) high wind speeds and lifting sand obstructed surveyors' ability to detect the lizard.

Two surveyors tapped the ground with 2.5m bamboo sticks in front of them while surveying in order to flush lizards. Microhabitat data was collected in addition to lizard numbers; this data included type of cover used, type of escape cover used, surface temperature, physical habitat (bowl, slip-face, dune ridge, sandy flat), habitat (active dune, psammophytic scrub), aspect, age (adult, sub-adult, hatchling), substrate the lizard was on, slope (degrees), and species. Approximately 99% of lizards observed were *Uma notata.* Results from these surveys are currently being analyzed.

A similar monitoring protocol will be implemented following plan completion. In addition to applying this protocol to the wilderness area and the open area immediately south of Highway 78, monitoring transects will also be established in the Adaptive Management Area and in the open area south of the Adaptive Management Area. Fewer transects per area will be read than the number read in 2001, since preliminary analysis of the 2001 data indicate that sufficient precision can be obtained with a lower number of transects. For those areas sampled in 2001, a subset of the transects run in 2001 will be selected according to a random design (i.e., either simple random sampling, systematic random sampling, or restricted random sampling) for future measurement. For those areas not yet sampled, the WESTEC grid will again be used as described above, with transects positioned using a random design.

Sampling Objective: Sampling will be designed to achieve yearly estimates of lizard density that are within 30% of the true lizard density at the 95% confidence level within each of the 4 sampling areas. This sampling objective may be modified based on pilot sampling.

Analysis: Lizard densities in each of the five sampled areas will be compared over time to determine if there is a trend in density over time. The densities for each of the four areas may also be compared to determine if there are significant differences in density between areas, but this difference will be difficult to interpret given the variability in topography and probably climate throughout the entire dune system. It may be possible to use a multivariate repeated measures analysis of variance, as described under the analysis section for special status plants, to see if the responses of the lizards in each of

the areas are parallel over time. The power of this analysis, however, depends upon the degree of correlation between years of each of the sampling units (belt transects). It is quite possible that this correlation will prove to be low with an organism this mobile, but pilot sampling should provide an answer.

Once more than 10 years of data are available, the parallel response hypothesis, even for independent samples, can be tested through regression analysis, treating density as the dependent variable and year as the independent variable.

FLAT-TAILED HORNED LIZARD

There have been approximately 20 sightings of the flat-tailed horned lizard (FTHL) in the Algodones Dunes, some well out in the dune interior. Foreman (1997) summarized existing information on FTHL habitat, concluding, "Flat-tailed horned lizards are probably rare in the unvegetated portions of major dune systems, such as the Algodones Dunes and the dunes of the Gran Desierto. (Luckenbach and Bury 1983, McCalvin 1993). However, much of the ISDRA is vegetated. Large areas of psammophytic scrub occur in the ISDRA. The only known surveys directed specifically toward the FTHL were conducted by BLM. These surveys looked at portions of the dunes near their perimeter (i.e., near roads) and consisted of 2.5 mile long belt transects that were 50 inches wide (Wright 2002). During the 77 hours spent walking these transects, two lizards were sighted (a rate of 0.026 lizards/hour). This sighting rate of 0.026 lizards/hour is much lower than sighting rates for other areas in California. West Mesa, for example, an area known to provide good habitat for the species, has a sighting rate of about 0.2 lizards/hour, while the California range as a whole is about 0.1 lizards/hour. These data appear to indicate that the FTHL is less abundant in the dunes, but the fact remains that the majority of the dunes have not been surveyed for the species.

The monitoring planned here is to search for FTHL on a randomly selected subset of the belt transects used for the Colorado Desert fringe-toed lizard. The FTHL will not be surveyed during the same time as the fringe-toed lizard transects because the FTHL will require considerably more time to read and because the FTHL must be surveyed following a wind event that erases previous lizard tracks (see below), a constraint not shared by the fringe-toed lizard monitoring.

Belt transects 724m (0.45 mile) long by 10m wide will be surveyed by teams of 2-3 observers. Observers will carefully walk the transects looking for either lizards or lizard tracks. If tracks are found, they will be followed in an attempt to find the lizard. If found the lizard will be counted as being in the belt transect. The parameter estimate will be the number of lizards detected per hour of survey. A separate estimate of this parameter will be obtained for each of the areas surveyed (Mammoth Wash, wilderness area, open area north of the Adaptive Management Area, Adaptive Management Area, open area south of the Adaptive Management Area).

Sampling Objective: No sampling objective is planned at this time. Studies in non-dune habitat (Wright 2002) have shown that detection rates of this cryptic animal can be very low and variable, leading to rather imprecise estimates of detection rate. The dune substrate allows observers to use tracks to locate lizards (something they were unable to do on other substrates), and this may result in lower coefficients of variation and more precise estimates of detection rate. On the other hand, the possible lower abundance of the lizard in the dunes may result in many zero values, leading to less precise estimates. Because of these unknowns, there is no reasonable means of estimating the potential coefficient of variation for FTHL data. Therefore, no sampling objectives will be set until pilot sampling yields an estimate of detection rate and its standard deviation.

Analysis: Analysis of FTHL detection rates will be conducted in a manner similar to that discussed above for Colorado Desert fringe-toed lizard density. Because FTHL estimates may not be very precise it may not be possible to detect other than drastic changes in FTHL abundance, but the monitoring will at least answer questions concerning whether psammophytic scrub supports many FTHL and, if so, what the FTHL distribution in the dunes is.

OHV USE

OHV use will be estimated by means of aerial photography. Sixteen air photo transects were established throughout the dunes in 1998 in order to obtain a sample of the distribution and intensity of OHV use in the dunes through the measurement of vehicle tracks. The aerial photographs obtained from these transects are at a 1:7000 scale, allowing the detection of vehicle tracks. These transects were flown on Easter weekend 1998 and reflown on Easter weekends in 1999, 2000, and 2001 (because of the ephemeral nature of vehicle tracks in sand, it was necessary to take the photographs during a weekend of relatively high vehicle use). The location of these air photo transects is shown in Willoughby (2000), along with the results of vehicle track frequency measurements for 1998.

During the first four years of RAMP implementation, aerial photography will be obtained for the entire ISDRA during three heavy-use weekends (Thanksgiving, Presidents' Day, and Easter) in one of these years and during one heavy-use weekend every year thereafter. The data from the three heavy-use weekends will be used to determine the timing of the yearly aerial photography.

Aerial photographs will be sampled by means of a grid of points to estimate the cover of vehicle tracks in the dunes. The size of the grid and number of points per transect will be determined based on pilot sampling to meet the sampling objective described below. Future aerial photographs will be registered so that sampling grids can be placed in the same area in each year.

Sampling Objective: Sampling will be designed to achieve yearly estimates of OHV track cover that are within 30% (relative) of the true OHV track cover at the 95%

confidence level within each of the 9 management sampling areas. It is unlikely this objective can be met for the wilderness area since the OHV track cover there will likely be extremely low. This sampling objective may be modified based on pilot sampling.

See the section for Peirson's milk-vetch for more information on how these estimates of OHV use will be used to make inferences concerning the effects of different levels of OHV use on particular species.

VISITOR USE

In order to obtain better estimates of visitor use on holiday weekends, the following three-part monitoring study is planned:

- Personnel will collect the following data at major dune entry points: types of vehicles entering the dunes, number of people in vehicles, and the types of OHV vehicles they are bringing into the dunes.

- Electronic vehicle counters will be used to count vehicles coming into the dunes. Local regressions on the data collected in Part 1 will be used to extrapolate the estimated population and the type and number of vehicles.

- Conduct demographic studies to obtain data on the willingness-to-pay and actual expenditure data by OHV recreation visitors under different adaptive management regimes. These elements respond to the need to account for the economic impact of OHV recreation visitors to communities.

WEATHER STATIONS

Long-term weather stations in the region do not completely capture the actual growing season precipitation occurring in the dunes. These weather stations are some distance from the dunes, the seasonal precipitation totals vary greatly between stations, and there is strong indication that precipitation varies considerably within the dunes during the same growing season (Willoughby 2000 and 2001). For these reasons, two Remote Area Weather Stations were set up in the dunes in fall 2000, one at the Cahuilla Ranger Station in the northwest part of the dunes and one at Buttercup Campground in the southern part of the dunes. These stations began collecting weather data on November 16, 2000. The Buttercup Station recorded significantly higher precipitation than the Cahuilla Station between November 2000 and December 2001. Because of this variability and the importance of precipitation in controlling the abundance of special status plants, the Colorado Desert fringe-toed lizard, and the flat-tailed horned lizard, more weather stations are necessary to enable good interpretation of the monitoring data collected. If adequate funding is secured, five additional remote area weather station facilities will be installed in the dunes. These new stations will be located approximately as follows: (1) in the extreme northern part of the dunes in the vicinity of Mammoth Wash; (2) at the

wildlife viewing area just northwest of Glamis; (3) along the Wash Road west of the junction of Ted Kipf and Vista Mine roads; (4) along the Wash Road west of Cactus; and (5) along the sand highway west of Tube 1.

Precipitation data gathered by the remote area weather stations will be compared to the results of monitoring to assist in determining whether a detected increase in the population of a special status species can be solely attributable to precipitation variability. This evaluation will assist in determining what, it any, management action is required in response to a detected change in population size.

Additional Funding Required to Support Monitoring

Additional funding will be required to accomplish the monitoring described above. This funding includes both one-time and yearly costs, as detailed below. Also see the monitoring/study implementation schedule and costs for special status plant monitoring, included in the section on Peirson's milk-vetch monitoring.

Need	One-time Cost	Yearly Cost
Personnel (monitoring, analysis, and GIS support)		$250,000
Vehicle maintenance		5,000
Remote Area Weather Stations (5 @ $25,000 each)	125,000	
Weather Station Maintenance		5,000
Aerial Photography and analysis costs in first 4 years of plan implementation	$186,000	
Aerial Photography and analysis yearly after first 4 years of plan implementation		62,000
Total	311,000	322,000

Personnel: Monitoring will be accomplished using a combination of full-time employees, seasonal employees, contractors, and volunteers. In addition to actually reading transects, two employees will provide logistical and safety support during monitoring periods (e.g., waiting at the end of transects with a vehicle, monitoring radio and telephone transmissions from monitors, etc.).

Remote Area Weather Stations: The need for these is discussed under the section on weather stations, above.

Aerial Photography: Sixteen air photo transects are currently being flown each year. The planned monitoring calls for complete coverage of the ISDRA during three heavy-use weekends (Thanksgiving, Presidents' Day, and Easter) in one of the first four years, and once every year thereafter. The exact location of each aerial photograph will be registered and incorporated into a GIS.

Literature Cited

Anderson, D. R., and K. P. Burnham. 1997. A monitoring program for the desert tortoise. Colorado Cooperative Fish and Wildlife Research Unit, Fort Collins, CO.

Anderson, D. R., K. P. Burnham, B. C. Lubow, L. Thomas, P. S. Corn, P. A. Medica, and R. W. Marlow. 2001. Field trials of line transect methods applied to estimation of desert tortoise abundance. Journal of Wildlife Management 65:583-597.\

Barneby, R. C. 1964. Atlas of North American Astragalus. Memoirs of the New York Botanical Garden 13:953-954.

Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 1998. Measuring and monitoring plant populations. Technical Reference 1730-1, Bureau of Land Management, Denver, CO.

Elzinga, C. L., D. W. Salzer, J. W. Willoughby, and J. P. Gibbs. 2001. Monitoring plant and animal populations. Blackwell Science, Malden, MA.

Foreman, L. D., ed. 1997. Flat-tailed horned lizard rangewide management strategy. Working Group of Flat-tailed Horned Lizard Interagency Coordinating Committee. Report available at Bureau of Land Management, California Desert District Office, Riverside, CA.

Habich, N., et al. 1996. Sampling vegetation attributes. U.S. Interagency Technical Reference, Bureau of Land Management, Denver, CO. 172 pp.

Holechek, J. L. 1988. An approach for setting the stocking rate. Rangelands **10**:10-13.

Holechek, J. L., R. D. Pieper, and C. H. Herbel. 1998. Range management: principles and practices, 3rd ed. Prentice Hall, Upper Saddle River, NJ.

Lucas, H.A., and G. A. F. Seber. 1977. Estimating cover and particle density using the line intercept method. Biometrika 64:618-622.

Luckenbach, R. A., and R. B. Bury. 1983. Effects of off-road vehicles on the biota of the Algodones Dunes, Imperial County, California. J. Applied Ecology 20:265-286.

McCalvin, C. 1993. Surveys for seven rare plant species, the flat-tailed horned lizard, and the Colorado Desert fringe-toed lizard. Report to Bureau of Reclamation, Boulder City, NV.

Pavlik, B.M. 1979. The biology of endemic psammophytes, Eureka Valley, California, and its relation to off-road vehicle impact. U.S. Bureau of Land Management, California Desert Planning Staff, Riverside, CA. On file at Bureau of Land Management, California State Office.

Phillips, A. M., III, D. J. Kennedy, and M. Cross. 2001. Biology, distribution, and abundance of Peirson's milkvetch and other special status plants of the Algodones Dunes, California. Final report prepared for the American Sand Association. Hemet, CA.

Phillips, A. M., III, and D. J. Kennedy. 2002. The ecology of *Astragalus magdalenae* var. *peirsonii*: distribution, reproduction and seed bank. Final report prepared for the American Sand Association. Flagstaff, AZ.

Society for Range Management. 1998. A glossary of terms used in range management, 4th edition. Society for Range Managment, Denver, CO.

Tabachnick, B.G., and L.S. Fidell. 2001. Using multivariate statistics, 4th edition. Allyn and Bacon, Boston, MA.

von Ende, C.N. 1993. Repeated-measures analysis: growth and other time-dependent measures. Pp. 113-137 in: S.M. Scheiner and J. Gurevitch, eds. Design and Analysis of Ecological Experiments. Chapman & Hall, New York and London.

WESTEC Services Inc. 1977. Survey of sensitive plants of the Algodones Dunes. Prepared for Bureau of Land Management, California Desert District. On file at the BLM California State Office, Sacramento, CA.

Willoughby, J. W. 2000. Monitoring of special status plants in the Algodones Dunes, Imperial County, California: Results of 1998 monitoring and comparison with the data from WESTEC's 1977 monitoring study. Bureau of Land Management, California State Office, Sacramento, CA.

Willoughby, J. W. 2001. Monitoring of special status plants in the Algodones Dunes, Imperial County, California: 1977, 1998, 1999, and 2000. Bureau of Land Management, California State Office, Sacramento, CA.

Wright, G. 2002. Draft flat-tailed horned lizard monitoring report. Bureau of Land Management, El Centro, CA.