

A Report Prepared for

The City of Sand City
Planning Department
1 Sylvan Park
Sand City, California 93955-3054

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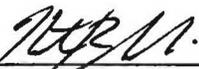
**SPRING 1993 MONITORING REPORT
HABITAT PRESERVE
SAND DOLLAR SHOPPING CENTER (PHASE I)
SAND CITY, CALIFORNIA**

HLA Project No. 23100 1

by



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April 30, 1993

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1.0 INTRODUCTION

Sand Dollar Shopping Center Habitat Preserve (Preserve) was created by the McDonald Development Company as mitigation for impacts to sensitive biological resources as a result of development of a regional shopping center in Sand City, California. The Preserve is the product of a Biological Resources Management Preserve Plan (Plan) prepared by Harding Lawson Associates (HLA, 1989). The primary goal of the Plan is "to provide 7.6 acres of an enhanced, unified, and permanently maintained and protected block of central dune scrub habitat on the project site that will support microclimates suitable for expansion of the resident population of Smith's blue butterfly (*Euphilotes enoptes smithi*), in conjunction with commercial development on a portion of the remainder of the site." Smith's blue butterfly is listed as federally endangered. The Preserve also supports state and federally proposed endangered sand gilia (*Gilia tenuiflora* ssp. *arenaria*), the federally proposed endangered Monterey spineflower (*Chorizanthe pungens*), and several federal candidates for listing, including California black legless lizard (*Anniella pulchra nigra*), coast wallflower (*Erysimum ammophilum*), Monterey ceanothus (*Ceanothus cuneatus* var. *rigidus*), and sandmat manzanita (*Arctostaphylos pumila*).

This monitoring report discusses management activities performed during the past year, describes monitoring methods and results obtained in Spring 1993, and provides recommendations regarding management of the Preserve.

2.0 SUMMARY OF MANAGEMENT ACTIVITIES

The McDonald Development Company has nearly completed the implementation phase of the Plan and continues with ongoing maintenance and monitoring activities. Activities described below include installation of additional plants, control of naturalized taxa, and collection of trash on the Preserve.

2.1 Plan Implementation

Seeds and cuttings from Monterey ceanothus and sandmat manzanita were collected locally by Sunset Coast Nursery to provide plants for the Preserve. Plants were installed in management areas 2A and 1B (Plate 1) for planting on December 5 and 7, 1992, by Patty Kriberg of Sunset Coast Nursery and George Robinette of Monterey Sand Company (Appendix A).

Ms. Joey Dorrell-Canepa (under a research grant from Moss Landing Marine Laboratory) is studying the Preserve as part of her master's degree program at San Jose State University. This research includes a number of experimental treatments within the Preserve and provides a mechanism for establishment of sand gilia onsite, as prescribed by the Plan. Seeds and seedlings were sown and planted in management areas 1A, 2A, and 3B. Approximately 1,130 sand gilia have been installed as of December 1992. Of the 130 sand gilia that became established under this study, 70 appear healthy and Ms. Dorrell-Canepa anticipates they will set seed this year (*Dorrell-Canepa, 1993*).

Although not required by the Plan, Monterey spineflower seeds were collected locally by Sunset Coast Nursery and hand broadcast in area 2A, in front of the interpretive center viewing platform, in September 1992. This seeding increases the aesthetic value and biological diversity of the Preserve and increases local populations of the federally proposed endangered Monterey spineflower. These activities constitute the

plant restoration component of the Plan, which is nearly complete. Table I lists by taxon the number of plants needed to complete planting as specified in the Plan.

2.2 Maintenance

As part of the naturalized plant control program, eight person-days at the Preserve were spent weeding, cutting, removing, and treating ripgut grass (*Bromus diandrus*) with Roundup and, hand-pulling and treating iceplant (*Carpobrotus edulis*) with Roundup. Herbicide application was performed by a certified applicator to selected areas. Trash was removed from the Preserve on a regular basis throughout the year (Robinette, 1993).

3.0 MONITORING METHODS

The monitoring program prescribed by the Plan examines the following three elements:

- Establishment of plant cover and progress toward development of a central dune scrub community
- Population studies of the Smith's blue butterfly and sand gilia
- Condition of engineered components (i.e., fencing, signs, slopes).

On March 25, 1993, HLA biologists monitored eight 100-foot linear transects to document plant establishment (Plate 1). Cover by taxon was measured and recorded in the field for plants located along established transects using the line intercept method (*Canfield, 1941*). Percent cover was calculated from field observations (Appendix B). Sand gilia were counted in two naturally occurring colonies in Management Area 1A. Baseline data were gathered for recently installed Monterey ceanothus and sandmat manzanita (Appendix B). On March 25, 1993, HLA biologists established two representative test plots and photo points for monitoring Monterey ceanothus and sandmat manzanita establishment within the newly planted areas (Plate 1). Plants located within test plots were counted, their health was rated, and their crown-diameter was measured to assess establishment progress for future monitoring reports. General conditions in each management area were noted and color photographs were taken from eight permanent Photo Points.

Surveys for Smith's blue butterfly were conducted under the direction of Dr. Richard Arnold between June 21 and August 12, 1992 (Appendix C). Field surveys were timed to coincide with the flight season of the butterfly. The Preserve was visited 15 times during this 7-week period. Four of the original five transects in the Preserve were lengthened based on an increase in the areal and numerical extent of buckwheat

(*Eriogonum* spp.) populations within the Preserve (Appendix C). Plants of this genus serve as host plants for Smith's blue butterfly. Buckwheat populations were sampled, and an index of Smith's blue butterfly abundance, based upon transect distance, was calculated.

Engineered Components consisting of the enclosing chain link fence supported by pressure treated wood, the lexan interpretive sign, and the pressure treated interpretive center were checked in the field signs of wear or damage.

4.0 MONITORING RESULTS AND DISCUSSION

4.1 Biological Components

The Preserve supports plant cover typical of that occurring in undisturbed and restored dunes in the Monterey Bay area (Plates 2-9). Total plant cover was slightly lower than in 1992, probably because the 1993 monitoring visit was conducted nearly 2 calendar weeks ahead of last year's visit. Native plant cover was 12.5 percent lower, while naturalized plant cover was 1.9 percent lower (Table 1). Substantial progress toward restoring the central dune scrub community as prescribed for the Preserve is still evident. Established plants appear healthy, provide dune stabilization, and help reduce weed proliferation.

The Phase I test plot supports 12 sandmat manzanita and 4 Monterey ceanothus and the Phase II test plot supports 19 sandmat manzanita and 7 Monterey ceanothus. Crown diameter of sandmat manzanita planted in Phase I ranged from 0.4 to 1.5 feet with a mean of 0.8 foot. Crown diameter of Monterey ceanothus in Phase I ranged from 1.0 to 1.5 feet with a mean of 1.3 feet. Crown diameter of sandmat manzanita planted in Phase II ranged from 0.2 to 1.0 foot with a mean of 0.5 foot. One of the sandmat manzanita plants in Phase II appeared dehydrated and chlorotic for unknown reasons. Crown diameter of Monterey ceanothus in Phase II ranged from 0.6 to 1.6 feet with a mean of 0.9 foot.

Dune and coast buckwheat (*Eriogonum parvifolium* and *E. latifolium*) continue to increase throughout the Preserve. Many of these plants have matured and produced flowers that provide nectar and oviposition (egg laying) sites for Smith's blue butterflies. Sand gilia is represented by two naturally occurring populations in Management Area 1A. HLA counted approximately 322 sand gilia plants, some of which were flowering at the time of the survey. This count has increased from the 60 plants

observed in 1991 and the 96 plants observed in 1992. The increase in sand gilia is apparently the result of favorable conditions created by Spring 1991 and Winter 1992 rainfall rather than any deliberate management activities. Sand gilia planted by Ms. Dorrell-Canepa has become established in the test plot areas onsite (Plate 1). Sand gilia and Monterey spineflower are viewable from the interpretive center. Monterey spineflower was blooming during the spring monitoring visit. Broadcast seeding has been successful for Monterey spineflower.

Ripgut grass occurs in dense stands on the slopes of Management Area 2B and above the hollow of Management Area 1A. The latter invasion constitutes a direct threat to the survival of one of the dune gilia populations. Careful mowing before seed set and hand pulling have helped to control the spread of ripgut grass on the Preserve. The rate of spread may be reduced once native shrubs colonize disturbed areas, and as the ripgut grass seed bank declines. Until then, active weed control (mechanical and chemical) must be of primary importance. Unless controlled, this naturalized grass will interfere with the establishment of native plants.

Iceplant continues to invade the site but is a relatively minor nuisance. Possible sources include the soil seed bank (viable seed buried in the sand) and invasion of seed and vegetative materials from the nearby Highway 1 right-of-way. This aggressive colonizer will be an ongoing management challenge until it is controlled locally. Hand pulling and limited herbicide use will keep iceplant from becoming a dominant presence at the site.

A total of 651 Smith's blue butterflies were observed on the Preserve during 15 days of the study period. The index of relative abundance for the Preserve was 36.4. Comparison of the 1991 and 1992 indices results suggests that population numbers

increased in 1992 along Transects 1, 2, and 5, apparently due to increasing numbers of buckwheat flowers observed along these transects during 1992. The increase in the buckwheat populations provides an increase in food source for the Smith's blue butterfly. Population numbers remained stable along Transects 3 and 4 (Appendix C).

4.2 Engineered Components

All engineered components installed under the Plan are in excellent condition. The fence surrounding the Preserve is intact and serves as an effective barrier to unauthorized use. Large boulders placed at critical maneuvering areas to reduce the risk of inadvertent damage to the fence by trucks servicing the shopping center are still in place. The interpretive center still provides an inviting area to view the Preserve. The slopes appear to be relatively stable, sliding or movement was not observed.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Development of a stabile central dune scrub habitat on the project site is promising. Percent cover of native plants in the Preserve has decreased slightly since Spring 1992, but this difference is probably the result of timing of the monitoring visit rather than mortality. The difference in vegetative cover appears to be related to annual variation in temperature and moisture regime. Winter/spring season of 1993 has been cooler and wetter than most of the 5 preceding years.

Naturalized weeds continue to be a nuisance. However, with an ongoing program of control and the eventual eradication of iceplant along Highway 1 and riggut grass between the Preserve and Highway 1, these aggressive colonizers will probably be a short-term concern. An increase in use of the Preserve by Smith's blue butterfly has been demonstrated. The population has significantly increased since the implementation of the Preserve. The naturally occurring sand gilia populations have increased in number substantially since Spring 1991.

The list of plants required to complete the revegetation component of the Plan (Table 1) should be reevaluated during Summer 1993 after maximum growth has been achieved for the year. Several species designated on the list to be planted have become successfully established and are naturally reproducing and should not be installed as previously specified. Beach primrose and seaside wooly sunflower are two of the plants abundant on the Preserve. A qualified biologist should evaluate the Preserve and the goals to complete the planting program. The availability of local seed, numbers to be planted and plants already present on the preserve should be considered. The list (Table 1) should be modified as necessary in order to complete the planting program in the most practical manner and attain a self-sustaining central dune scrub community.

HLA offers the following recommendations for management of the Preserve in 1993.

- Provide control of naturalized plants on the adjacent Calabrese property by spraying, hand pulling, and mowing ripgut grass
- Work with Caltrans on a program to eliminate iceplant and ripgut grass from the adjacent Highway 1 right-of-way
- Plant Monterey ceanothus, sandmat manzanita, coyote brush, and yellow sand verbena in management area 2B as specified by the Plan to help control ripgut grass
- Reevaluate the list of plant species to be installed and install additional plants as prescribed in the Plan
- Use a selective herbicide to target ripgut grass (avoiding special-status species).

6.0 REFERENCES

- Canfield, R.H. 1941. *Application of the Line-intercept Method in Sampling Range Vegetation*. Journal of Forestry. 39(4):388-394
- Dorrell-Canepa, J., 1993. Telephone communication with Cheryl Sorensen, Harding Lawson Associates. April 22.
- Harding Lawson Associates (HLA), 1989. *Biological Resource Management Plan, Sand City Regional Shopping Center*. Report prepared for EMC Planning Group, Inc., Monterey, California. February 1. 47pp.
- _____, 1991. *Spring 1991 Monitoring Report, Sand Dollar Shopping Center*. Report prepared for the City of Sand City, California. May 3. 4pp.
- Hickman, J.C. (Ed.) 1993. *The Jepson Manual: Higher Plants of California*, Berkeley: University of California Press.
- Robinette III, G.H., 1993. Monterey Sand Company. Facsimile to Harding Lawson Associates. April 20.

TABLES

**Table 1. List of Plants Prescribed for Installation,
Numbers of Plants Installed to Date, and
Numbers of Plants Required to Complete the
Revegetation Component of the Plan.
Sand Dollar Shopping Center
Sand City, California**

Scientific Name	Common Name	Numbers Specified	Total Installed	Number Still Required
<i>Abronia latifolia</i>	yellow sand verbena	900	509	391
<i>Abronia umbellata</i>	pink sand verbena	550	354	196
<i>Achillea millifolium</i>	yarrow	150	193 ^a	0
<i>Ambrosia chamissonsis</i>	ambrosia	1,200	794	406
<i>Arctostaphylos pumila</i>	sandmat manzanita	500	25	475
<i>Artemisia pycnocephala</i>	dune sagebrush	2,000	1,975	25
<i>Baccharis pilularis</i>	coyote brush	600	0	600
<i>Camissonia cheiranthifolia</i>	beach primrose	1,400	0	1,400
<i>Ceanothus cuneatus</i> var. <i>rigidis</i>	Monterey ceanothus	500	8	492
<i>Lessingia californica</i> var. <i>californica</i>	California beach aster	1,200	582	618
<i>Eriogonum latifolium</i>	coast buckwheat	2,500	2,654 ^a	0
<i>Eriogonum parvifolium</i>	dune buckwheat	2,500	2,601 ^a	0
<i>Eriophyllum staechadifolium</i>	seaside wooly sunflower	1,800	790	1,010
<i>Erysimum ammodophilum</i>	coast wallflower	200	185	15
<i>Gilia tenuiflora</i> ssp. <i>arenaria</i>	sand gilia	150	1,113 ^a	0
<i>Poa douglasii</i>	dune bluegrass	500	116	384
<i>Rhamnus californica</i> ssp. <i>californica</i>	coffeeberry	200	150	50
	Total	16,850	12,049	6,062

a Note that additional plants have been installed in these cases.

Table 2. Percent Cover for Plants Occurring in the Sand Dollar Shopping Center Habitat Preserve

Management Area	1991				1992				1993				Change Since 1992
	1A	2A	2B	Average	1A	2A	2B	Average	1A	2A	2B	Average	
Native Plants	20.4	18.9	22.0	20.4	40.1	39.3	54.6	44.7	41.3	25.9	29.4	32.2	-12.5
Naturalized Plants	2.0	2.7	19.4	8.0	12.5	6.3	26.6	15.1	14.2	7.5	18.0	13.2	-1.9
Total	22.4	21.6	41.4	28.4	52.6	45.6	81.2	59.7	55.5	33.4	47.4	45.4	-14.4

Area Key (Plate 1)

- 1A = Top of Dune, west facing slope
- 2A = East face of Dune
- 2B = Flat Area west of viewing platform

PLATES





on Associates





Associates





Lawson Associates



APPENDIX A - PLANTS INSTALLED DECEMBER 1992

MONTEREY SAND CO., INC.
DEC 11 '92 AM 9:29
Industrial Sands

P.O. BOX 3055 • MONTEREY, CALIFORNIA 93942

Phone (408) 394-6541

Fax (408) 394-8360

Phone (800) 824-3996

Inside Calif. (800) 824-3995



December 8, 1992

Mr. Kelly Morgan
Planning Director
City of Sand City
#1 Sylvan Park
Sand City, CA 93955

Dear Kelly:

This is an update of our efforts with the Habitat Restoration Program for Sand Dollar Center. On December 5 and 7, 1992 the following work was performed:

In Management Area 2A (immediately behind Orchard Supply Hardware) 25 Sandmat Manzanita and 4 Monterey ceanothus plants were introduced. These plants were grown in one gallon cans by Patti Kriebberg at Sunset Coast Nursery. The manzanita were grown from cuttings and seed and the ceanothus were started from seed. All cuttings and seed were collected from our land north of Playa Ave. and west of the railroad ROW by Patti Kriebberg. Four other Monterey ceanothus are growing from cuttings introduced in 1989 by Kirk Ford and Gerd Schneider.

In Management Area 1B (the 4.26 acre parcel north of Playa and east of Highway 1) 50 Sandmat manzanita and 21 Monterey ceanothus were planted. These plants were planted in the general area of the flat swale along the eastern boundary and the hillside corner at Playa and the rear of Bell Magazine.

All plants were flagged and will be monitored. The usual ice-plant eradication was continued in Area 2A. One manzanita was placed in the irrigated island at the corner of Metz and Playa so that its progress could be compared with the non-irrigated plants in the management areas.

Very truly yours,

George H. Robinette III
President

cc: ✓ Dr. Kent Julin, HLA
George Kurilko, LSA

SUNSET COAST NURSERY
PO BOX 221
WATSONVILLE, CA 95077
(408) 726-1672

DATE: Dec. 4, 1992

DELIVERY
INVOICE #120292

NAME: Monterey Sand Co., Inc.
ADDRESS: P.O. Bx 3055
Monterey, CA 93940
PHONE: 394-6541 (George Robinette)
JOB:

size/quantity

$\begin{array}{r} 38 \\ + 24 \\ + 14 \\ \hline 76 \end{array}$ 1 gal Arctostaphylos pumila
Sandmat manzanita

$\begin{array}{r} 12 \\ + 10 \\ + 3 \\ \hline 25 \end{array}$ 1 gal Ceanothus rigidus
Monterey ceanothus

The above listed plants were grown from cutting (Arctostaphylos and Ceanothus) or seed (Ceanothus) material collected from site North of Playa Avenue, Sand City, CA. November 1991

Received by: Richard H. G.

THANK YOU

APPENDIX B - MONITORING DATA

Table B-1
Monitoring Data from Transects

Harding Lawson Associates

Scientific Name*	Common Name	Transects			Average	Transects			Average Transects			Average	Species	Species
		1A1	1A2	1A3	1A	2A1	2A2	2A3	2A	2B1	2B2	2B	Average 1993	Average 1992
		%	%	%	%	%	%	%	%	%	%	%	%	%
<i>Abronia latifolia</i>	yellow sand verbena													
<i>Abronia umbellata</i>	pink sand verbena										1.0	0.3	0.1	1.5
<i>Ambrosia chamissonsis</i>	ambrosia													0.3
<i>Arctostaphylos punila</i>	sandmat manzanita													
<i>Artemisia pycnocephala</i>	dune sagebrush	1.0	18.4	15.7	11.7	5.2	34.9		13.4	11.0	0.7	8.4	11.1	11.3
<i>Atriplex leucophylla</i>	dune saltbrush													
<i>Avena fatua</i>	wild oat									0.6		0.2	0.1	2.9
<i>Baccharis pilularis</i>	coyote brush													
<i>Bromus diandrus</i>	ripgut grass	17.5		9.5	9.0		6.9	0.7	2.5	39.0	7.0	16.2	9.2	10.2
<i>Cakile maritima</i>	sea rocket													0.5
<i>Camissonia cheiranthifolia</i>	beach evening primrose		0.8		0.3	1.0	1.7	0.6	1.1		1.8	1.0	0.8	6.2
<i>Carpobrotus edulis</i>	iceplant													0.1
<i>Ceanothus cuneatus var. rigidis</i>	Monterey ceanothus						2.0		0.7			0.2	0.3	0.2
<i>Chamomilla suaveolens</i>	pineapple weed													0.0
<i>Chorizanthe pungens var. pungens</i>	Monterey spineflower						0.8		0.3			0.1	0.1	
<i>Claytonia perfoliata</i>	miner's lettuce	11.0		15.0	8.7		3.0		1.0			0.3	3.3	2.6
<i>Cucurbita foetidissima</i>	Calabazilla	15.5		0.2	5.2								1.7	1.7
<i>Dudleya caespitosa</i>	liveforever			0.4	0.1	0.6			0.2		0.2	0.1	0.2	0.0
<i>Ericameria eastwoodii</i>	mock heather	15.6		8.8	8.1								2.7	0.9
<i>Ericameria fasciculata</i>	Eastwood's goldenbush													0.6
<i>Eriogonum latifolium</i>	coast buckwheat										1.4	0.5	0.2	0.4
<i>Eriogonum parvifolium</i>	dune buckwheat	2.1	2.9	3.4	2.8	1.0	1.1	1.3	1.1	2.5	0.1	1.2	1.7	0.7
<i>Eriophyllum staechadifolium</i>	Seaside wooly flower						0.6		0.2			0.1	0.1	0.5
<i>Erodium cicutarium</i>	redstem storksbill						3.0	4.9	2.6			0.9	1.2	0.4
<i>Eschscholzia californica</i>	California poppy									1.8		0.6	0.2	0.5
<i>Gilia tenuiflora ssp. arenaria</i>	sand gilia		0.1		0.0								0.0	
<i>Heterotheca grandiflora</i>	telegraph weed							0.3	0.1			0.0	0.0	0.1
<i>Hordeum murinum ssp. leporinum</i>	hare barley							0.3	0.1			0.0	0.0	0.1
<i>Horkelia californica var. californica</i>	horkelia													0.2
<i>Lessingia californica var. californica</i>	California beach aster													
<i>Lotus scoparius</i>	California broom		5.4		1.8	6.0	1.7	8.6	5.4	15.4	10.9	10.6	5.9	8.6
<i>Lupinus chamissonsis</i>	bush lupine	1.0			0.3			6.9	2.3	11.0	4.5	5.9	2.9	5.3
<i>Medicago polymorpha</i>	California burclover							4.5	1.5			0.5	0.7	0.5
<i>Picris echioides</i>	bristly ox-tongue					0.3	0.3		0.2			0.1	0.1	
<i>Poa douglasii</i>	sand-dune bluegrass	1.2			0.4								0.1	1.1
<i>Rhamnus californica ssp. californica</i>	California coffeeberry	1.5		3.8	1.8								0.6	0.2
<i>Senecio vulgaris</i>	common butterweed	0.3		0.3	0.2	0.3	0.5	0.3	0.4			0.1	0.2	0.4
<i>Solanum umbelliferum</i>	nightshade							0.4	0.1			0.0	0.1	0.1
<i>Sonchus oleraceus</i>	common sowthistle		0.3	0.3	0.2			0.2	0.1			0.0	0.1	
<i>Spergularia bocconii</i>	sand-spurrey							0.4	0.1			0.0	0.1	
<i>Stellaria media</i>	shiny chickweed	2.2		12.3	4.8								1.6	1.5
	Percent Cover by Transect	68.9	27.9	69.6		14.4	56.5	29.4		81.3	27.6		45.4	59.7
	Percent Cover by Area				55.5				33.4			47.4		

*Nomenclature changes have been made to some of the above listed plants. Please refer to Table B-3.

Table B-2. Monitoring Data from Test Plots

Scientific Name	Common Name	Number Planted Phase 1	Number Planted Phase II
<i>Ceanothus cuneatus</i> var. <i>rigidis</i>	Monterey ceanothus	4	21
<i>Arctostaphylos pumila</i>	Sandmat manzanita	25	50
Total Planted		29	71

Table B-3. Addendum B-3
Nomenclature Changes from Recent References

Accepted Nomenclature	Previously Accepted Nomenclature	Common Name
<i>Ceanothus cuneatus</i> var. <i>rigidis</i>	<i>Ceanothus rigidis</i>	Monterey ceanothus
<i>Lessingia californica</i> var. <i>californica</i>	<i>Corethrogyne californica</i>	California beach aster
<i>Ericameria fasciculata</i>	<i>Ericameria ericoides</i>	Eastwood's goldenbush
<i>Hordeum murinum</i> ssp. <i>leporinum</i>	<i>Hordeum leporinum</i>	hare barley
<i>Horkelia californica</i> var. <i>californica</i>	<i>Horkelia californica</i>	horkelia
<i>Chamomilla suaveolens</i>	<i>Matricaria matricarioides</i>	pineapple weed
<i>Rhamnus californica</i> ssp. <i>californica</i>	<i>Rhamnus californica</i>	California coffeeberry
<i>Solanum umbelliferum</i>	<i>Solanum douglasii</i>	nightshade

**APPENDIX C - SMITH'S BLUE BUTTERFLY
MONITORING REPORT**

**1992 MONITORING REPORT
FOR THE ENDANGERED
SMITH'S BLUE BUTTERFLY
AT THE SAND DOLLAR SHOPPING CENTER
IN SAND CITY, CALIFORNIA**

**Prepared For:
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Sand City, CA 93942**

**Prepared By:
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**Report Date:
15 September 1992**

INTRODUCTION

Monitoring surveys to estimate the relative abundance of the endangered Smith's Blue butterfly, *Euphilotes enoptes smithi*, were conducted for a second consecutive year at the Sand Dollar Shopping Center, located in Sand City, California, during the butterfly's 1992 flight season. The butterfly monitoring is one component of the longterm resource management program for the shopping center (Harding Lawson Associates 1989). During the butterfly's 1991 flight season, relative abundance of the butterfly was estimated using a transect count method described by Pollard et al. (1974) in the Phase I mitigation portion (Management Areas 1A, 2A, and 2B) of the shopping center project site (Entomological Consulting Services, Ltd. 1991). In 1992, monitoring surveys were repeated in the Phase I area, and expanded to include Management Areas 1B and 3B (Figure 1). The transect count method was used to estimate the butterfly's relative abundance in 1992, to permit comparison of results from both years.

All field studies described in this report were conducted between June 21st and August 12th, 1992. The project site was visited 15 times during this seven-week period. In Management Areas #1A, 2A, and 2B, which is also referred to as the Phase I mitigation site, five transects (#1 - #5 in Figure 1), which were utilized during the 1991 monitoring studies, were sampled in 1992 to estimate relative abundance of the Smith's Blue. Also, two new transects (#6 and #7 in Figure 1) were established in Management Area 3B and one new transect (#8 in Figure 1) was established in Management Area 1B. The results of annual monitoring of the Smith's Blue allows the resource manager to detect significant changes in the population numbers of the endangered butterfly and to evaluate the success of management activities to benefit the butterfly.

METHODS

Pollard et al. (1974) described a transect count method for estimating relative abundance of butterflies. The data collection and analytical methods employed during the 1992 monitoring surveys were identical to those described in the 1991 monitoring report (Entomological Consulting Services, Ltd. 1991).

Briefly, Pollard's transect method, as it was used to estimate relative abundance of the Smith's Blue, can be described as follows. Transects were established in five management areas of the shopping center. In Management Areas #1A, 2A, and 2B, five transects, as used in 1991, were sampled in 1992. However, because the buckwheat (*Eriogonum*) foodplants growing along each transect had increased in number and flower production, the length of each transect was increased for the 1992 surveys. Two transects were established in Management Area #3B and one transect was established in Management Area #1B. The locations of these transects were selected after a reconnaissance of both parcels to identify where the buckwheat foodplants (*Eriogonum parvifolium* and *E. latifolium*) of the Smith's Blue grew. The length of each transect was

measured using a ROLATAPE measuring wheel (Table 1). The starting, ending, and any intermediate points along each transect path were flagged and uniquely identified in the field.

The transect locations (Figure 1) at the Sand Dollar Shopping Center can be described as follows:

- a) Transect #1 crosses Management Areas #2A, 2B, and 1A and supports resident plants of both *Erigeron parvifolium* and *E. latifolium*;
- b) Transect #2 is located in Management Area #1A, and supports resident and revegetated plants of primarily *E. parvifolium*, and lesser numbers of *E. latifolium*;
- c) Transect #3 is located in Management Area #1A, and supports resident and revegetated plants of primarily *E. parvifolium*, and lesser numbers of *E. latifolium*;
- d) Transect #4 is located in Management Area #1A, and supports resident and revegetated plants of primarily *E. latifolium*, and lesser numbers of *E. parvifolium*;
- e) Transect #5 is located in Management Area #2B, and supports resident and revegetated plants of *E. parvifolium* and *E. latifolium* growing in approximately equal numbers;
- f) Transect #6 is located in the Southern Pacific railroad right-of-way, immediately east of Management Area #3B, and supports resident plants of primarily *E. latifolium* and lesser numbers of *E. parvifolium*;
- g) Transect #7 is located in Management Area #3B, and supports resident plants of primarily *E. parvifolium* and lesser numbers of *E. latifolium*; and
- h) Transect #8 is located in Management Area #1B, and supports resident plants of primarily *E. parvifolium* and lesser numbers of *E. latifolium*.

The length of each transect was determined by the distribution of buckwheat foodplants along each transect. Transects #1, #2, #3, and #4 were lengthened in 1992 because additional buckweats were flowering compared to 1991. All of the transects supported a mixture of seedlings, juveniles, and mature buckweats, although the proportion of these age classes varied among the transects.

On 15 days during the Smith's Blue 1992 flight season, between June 21st and August 12th, each transect was walked at a constant pace. As adult Smith's Blues were observed, information about their sex, behavior, plant association, observation time, wing wear, and weather conditions were recorded on a data form. No butterflies were captured or otherwise handled. Butterflies of questionable identity were also noted, but not included in the transect counts. The starting and ending time of each transect count was also recorded on the data form. Wing wear was classified into one of three categories, fresh, slightly worn, or very worn, based on the progressive deterioration of brilliant wing colors and increasing chips and tears in the wings that occur with increasing age of the butterflies.

Like all butterflies, the Smith's Blue is cold-blooded and requires the radiant energy of the sun to be active. Thus, low air temperature, cloud cover, and strong winds can adversely affect butterfly activity. For this reason, all transect counts were performed when weather conditions were favorable for butterfly activity, i.e., air temperatures > 60°F, light breezes or

no winds, and sunny or partly cloudy skies. Air temperatures and wind velocities were measured with hand-held instruments, or deemed suitable because other butterflies were active.

The sequence in which transects were walked for the butterfly counts on different days was randomized to insure that each transect was sampled at various times of day throughout the adult flight season. Table 2 describes the sampling order for the eight transects. Because there were only two transects in Management Area #3B, the sampling sequence for the transects alternated on each survey date. Although there was only one transect in Management Area #1B, surveys were alternately walked in north to south, and south to north directions to prevent repeated sampling in the same place at the same time on different visits.

In addition to the transect survey time, extra time was spend in Management Area #3B and the adjacent railroad right-of-way. The purpose of spending this additional effort was to determine the status of the Smith's Blue in this portion of the shopping center site.

RESULTS AND DISCUSSION

Transect counts of Smith's Blue adults were performed on 15 days between June 21st and August 12th. The actual numbers of adults observed along each transect on each count day and for the entire study period are presented in Table 3. Throughout the flight season, a total of 803 adults were observed. The vast majority of butterfly observations, 753 of 803 total, occurred along transects #2, #3, #8, #1, and #4. Only 50 blues were observed along transect #5, while no butterflies were observed along either transects #6 and #7.

Observed behaviors, which are summarized by transect in Table 4, included nectaring (n = 67), flying (n = 451), perching or basking (n = 265), and courtship or mating (n = 20). The primary plant associations for the non-flying behaviors were the butterfly's foodplants, *Eriogonum parvifolium* and *E. latifolium*.

Weather conditions were generally favorable for butterfly activity on all days, with temperatures ranging from the mid 60's to mid 80's °F. Winds generally consisted of just light breezes. Cloud cover was generally absent, or only partly cloudy. On each day that transect counts were taken, other butterfly species were active, which suggest that the blues could be active. All surveys occurred between the hours of 0930 and 1530 PDT.

To facilitate comparison of results between the transects, an index of butterfly abundance, based on the number of butterflies observed per foot of transect length, was calculated for every transect and each day of the surveys. All index values are presented in Table 5.

Table 1. Distances, measured in feet, for each of the transects used to estimate relative abundance of the Smith's Blue butterfly in 1992 at the Sand Dollar Shopping Center management sites. For those transects, whose lengths were extended for the 1992 monitoring, the 1991 transect lengths are noted in parentheses.

Transect =====	Distance =====
Management Areas #1A, 2A, & 2B:	
#1	328 (168)
#2	176 (108)
#3	255 (187)
#4	279 (217)
#5	155
Management Area #3B:	
#6	331
#7	504
Management Area #1B:	
#8	424

Table 2. Transect sampling order for each date of the Smith's Blue butterfly monitoring study in 1992 at the Sand Dollar Shopping Center.

Date =====	Transect Sampling Order =====
6/21	1, 2, 3, 4, 5, 6, 7, 8
6/26	2, 1, 4, 3, 5, 8, 7, 6
7/1	5, 3, 2, 1, 4, 6, 7, 8
7/7	6, 8, 7, 4, 3, 2, 1, 5
7/11	1, 2, 3, 5, 4, 6, 7, 8
7/12	6, 8, 7, 4, 3, 2, 1, 5
7/15	2, 3, 4, 1, 5, 8, 6, 7
7/17	4, 3, 2, 5, 1, 8, 7, 6
7/19	1, 2, 3, 4, 5, 8, 6, 7
7/23	2, 4, 3, 1, 5, 7, 8, 6
7/28	8, 7, 6, 3, 5, 1, 4, 2
7/31	4, 1, 3, 2, 5, 7, 8, 6
8/4	6, 8, 7, 5, 3, 1, 2, 4
8/7	1, 3, 2, 4, 5, 7, 8, 6
8/12	8, 7, 6, 3, 4, 5, 1, 2

Table 3. Numbers of Smith's Blue butterflies observed along each transect on every count day, along with daily totals (sum of observations along all four transects for a particular day) and seasonal totals (sum of all daily totals).

Date	T R A N S E C T								Daily Total
	#1	#2	#3	#4	#5	#6	#7	#8	
6/21	8	17	11	9	8	0	0	22	75
6/26	20	28	41	28	15	0	0	34	166
7/1	26	37	29	27	18	0	0	39	176
7/7	36	29	35	32	3	0	0	8	143
7/11	6	15	8	3	0	0	0	9	41
7/12	9	10	11	3	0	0	0	13	46
7/15	8	12	8	5	0	0	0	8	41
7/17	9	9	8	2	1	0	0	2	31
7/19	2	2	1	1	1	0	0	2	9
7/23	8	10	7	8	2	0	0	10	45
7/28	5	3	2	1	1	0	0	3	15
7/31	2	2	1	1	1	0	0	2	9
8/4	2	0	0	1	0	0	0	0	3
8/7	2	0	0	1	0	0	0	0	3
8/12	0	0	0	0	0	0	0	0	0
Totals	143	174	162	122	50	0	0	152	803
(by transect)									(Seasonal total)

Table 4. Numbers of Smith's Blue butterflies observed along each transect, along with a breakdown by behavior.

Behavior	T R A N S E C T								Behavior Totals
	#1	#2	#3	#4	#5	#6	#7	#8	
Nectaring	16	15	8	13	7	0	0	8	67
Perch/Bask	35	68	47	33	18	0	0	64	265
Flying	82	87	105	74	23	0	0	78	451
Court/Mate	8	4	2	2	2	0	0	2	20
Totals	143	174	162	122	50	0	0	152	803

Table 5. Indices of relative abundance for the Smith's Blue butterfly for every transect and survey day during its 1992 flight season at the Sand Dollar Shopping Center, measured by the number of butterflies observed per foot of transect. (Note: all index values should be multiplied by 10^{-3}).

Date	T R A N S E C T								Daily Index ^b
	#1	#2	#3	#4	#5	#6	#7	#8	
6/21	24 ^a	101	43	32	52	--	--	52	31
6/26	61	159	161	100	97	--	--	80	68
7/1	79	210	114	97	116	--	--	92	72
7/7	110	165	137	15	19	--	--	19	58
7/11	18	85	31	11	--	--	--	21	17
7/12	27	57	43	11	--	--	--	31	19
7/15	24	68	31	18	--	--	--	92	17
7/17	27	51	31	7	6	--	--	5	13
7/19	6	11	4	4	6	--	--	5	4
7/23	24	57	27	29	12	--	--	24	18
7/28	15	17	8	4	6	--	--	7	6
7/31	6	11	4	4	6	--	--	5	4
8/4	6	--	--	4	--	--	--	--	1
8/7	6	--	--	4	--	--	--	--	1
8/12	--	--	--	--	--	--	--	--	--
Seasonal Index ^c =									22

NOTES:

a) Daily transect index values were calculated by dividing the number of butterflies observed along the transect on a given day (Table 3) by the length of that transect (Table 1). For example, the daily transect index value for transect #1 on July 7th is: 36 butterflies/ 328 feet = 110.0×10^{-3} butterflies per foot.

b) A daily index for all eight transects was calculated by dividing the total number of butterflies observed on a particular date (from Table 3) by the length of all eight transects (2,452 feet from Table 1). For example, the daily index for July 7th is: 143 butterflies/2,452 feet = 58.0×10^{-3} butterflies per foot.

c) The seasonal index was calculated by dividing the total number of butterflies observed during the 15 survey days (803 in Table 3) by the length of all eight transects (2,452 feet) times 15 visits: $803/(2,452 \times 15) = 22.0 \times 10^{-3}$ butterflies per foot.

Transect #2 had the highest daily index values of the eight transects. No butterflies were observed along transects #6 or #7 throughout the entire flight season. Transect index values ranged from 0.0 to 210×10^{-3} butterflies per foot (Table 5).

Comparison of 1991 and 1992 index results suggest that population numbers increased in 1992 along transects #1, #2, and #5, probably due to increasing numbers of buckwheat flowers observed along these transects during 1992. Population numbers remained stable along transects #3 and #4. Nonetheless, the seasonal index for 1992 (22) was approximately one-half of the comparable 1991 index (44.8), which suggests an overall decline in butterfly numbers. The lack of observations along transects #6 and #7, throughout the butterfly's flight season, contributed to a lower seasonal index for 1992. When these two transects are omitted from the seasonal index calculation, the index increases to 33, which is only slightly lower than the 1991 index.

Another factor that may have influenced the relative estimates of butterfly abundance, was the differential timing of the 1991 and 1992 flight seasons. Examination of wing wear data for both years, suggests that the Smith's Blue flight season began approximately one month earlier in 1992 than in 1991. During 1992, butterflies were first active about June 10th and concluded their flight season by August 12th. The 1992 peak in adult numbers occurred during the week of June 26th, whereas we didn't even observe our first butterflies until July 12th in 1991. Even though we started our monitoring surveys on June 21st in 1992, the butterfly had already been active for about 10 days, thus we missed some of the early emergence period, which could have dampened our seasonal index value for 1992.

The lack of butterfly observations in Management Area #3B and the adjacent railroad right-of-way, suggests that the Smith's Blue butterfly is not now utilizing this area. This is the second year that we have not observed any adults of the Smith's Blue using this area. Since many of the buckwheats growing in area #3B are juvenile or senescent plants, which do not produce as many flowers as robust mature plants, the lack of butterfly observations is not surprising because the butterfly obtains nearly all of its larval and adult nutrition from the flowers of the buckwheat. In addition to the transect monitoring, we spent nearly an additional 40 hours, scattered over 15 visits, searching for Smith's Blue in Management Area #3B. All search time was during good weather conditions, and on days when Smith's Blue adults were active at other Management Areas of the shopping center. Because adults of Smith's Blue adults were not observed here, coupled with the relatively few numbers of buckwheat flowers, it is unlikely that the butterfly is breeding in this portion of the shopping center at this time.

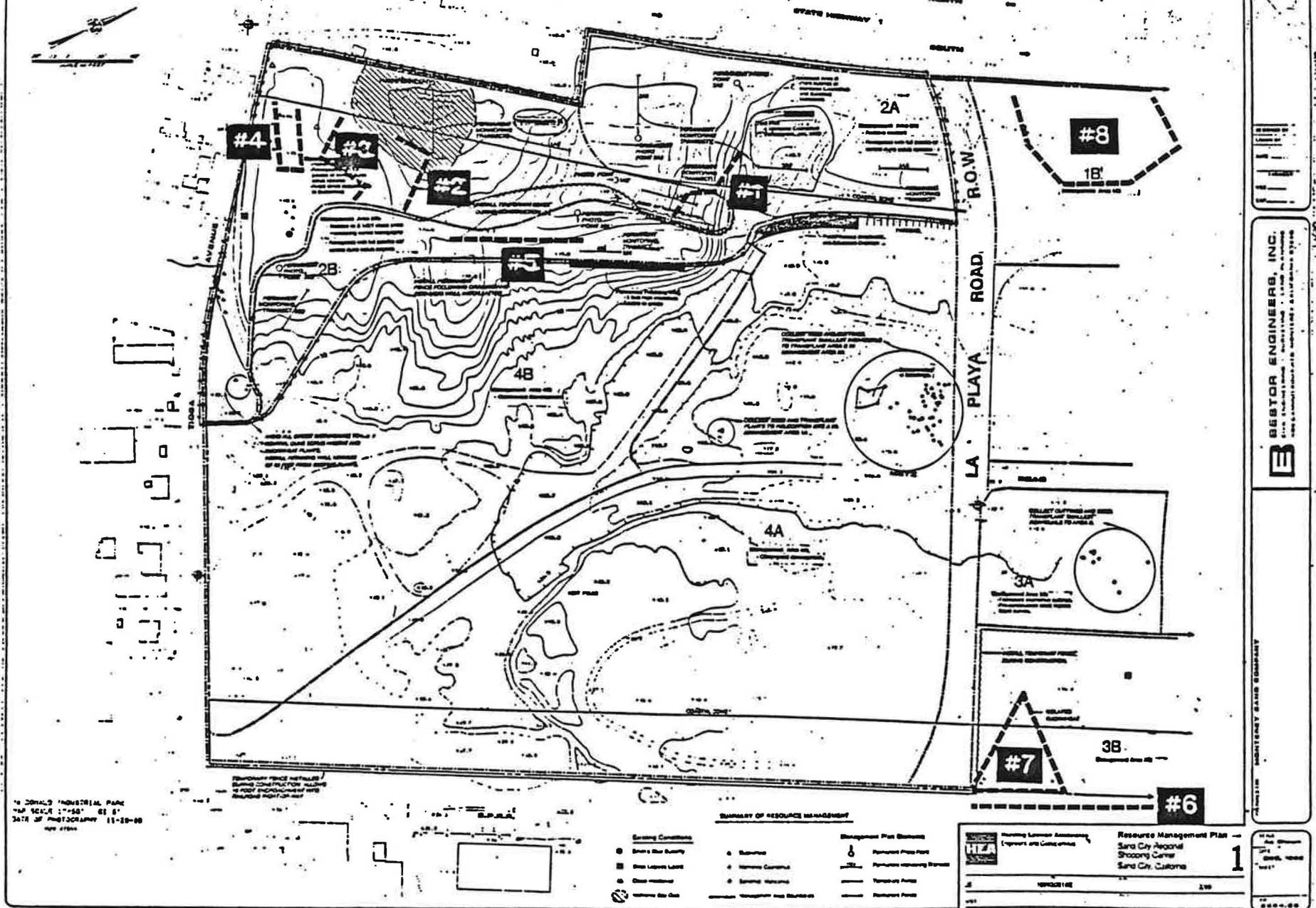
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FIGURE 1. Butterfly transect locations (#1 - #8) at the Sand Dollar shopping center.



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