

**City of San Diego
Multiple Species Conservation Program**

**Summary of Monitoring Results for
Dudleya blochmaniae ssp. *brevifolia***

May 2001

Introduction

Short leaved dudleya (*Dudleya blochmaniae* ssp. *brevifolia*) is listed by the State Government as an endangered plant species. The only five known occurrences of this extremely rare plant are Carmel Mountain, Del Mar Heights (Crest Canyon), Skeleton Canyon (UCSD), Torrey Pines State Park, and Torrey Pines State Park Extension. This plant is a perennial herb that typically blooms between April and June.

The surveys conducted are listed in Table 1 below. The methodology and results of the monitoring are detailed below. The goal of the effort was to continue long-term monitoring of short-leaved dudleya under the Multiple Species Conservation Program (MSCP).

Table 1: Dudleya Monitoring Surveys Dates

Date	Location	Surveyors
March 23, 2001	Carmel Mountain	Holly Boessow, Mark Doder, Jim Harry, Randy Rodriguez, Michael Klein
May 23, 2001	Crest Canyon, Skeleton Canyon, Torrey Pines State Park	Holly Boessow, Keith Greer, Jim Harry, Randy Rodriguez, Michael Klein, Dr. Michael Wells, Isabelle Kay
May 25, 2001	Carmel Mountain	Holly Boessow, Keith Greer, Jim Harry, Randy Rodriguez, Michael Klein, Isabelle Kay
June 4, 2001	Crest Canyon	Holly Boessow, Michael Klein, Jim Harry

Methodology

Monitoring for this species was conducted in accordance with the Biological Monitoring Plan for the Multiple Species Conservation Program, dated January 25, 1996 (CDFG, 1996). In 2001, all survey sites were mapped using a sub-meter GPS. If populations were small enough, a comprehensive census of the individuals was done. For larger populations, transects were done or the limits of the population were mapped. For each specific site, the methodology is described below.

Carmel Mountain

Three separate sampling areas, designated subpopulation 1 through 3, were located on Carmel

Mountain during the previous 1999 surveys (see attached map). An additional subpopulation of small size was located on a mesa adjacent to subpopulation 1 during the 2001 surveys. The location of each sampling area was determined by field level surveys and then depicted on aerial photographs.

The sampling areas were measured in 1999. Transects were selected randomly in 1999 and steel rods were installed to indicate the location of each transect. The transects are of varying lengths. The total number of transects (N=19) installed in all three sampling areas was determined by the total number of quadrats (N=59) required to sample approximately 5% of the total area of all three sampling areas. A census of the new small subpopulation was also conducted.

All transects were relocated except for both transects within sampling area two. These transects were replaced. Once the transects were relocated or replaced, string was run along the route of the transect. A one meter square (1 m²) quadrat was used to define the quadrat boundary and estimate population size. The 1 m² quadrat was placed along the left side of the transect. Each plant located within the 1 m² quadrat was counted and the total number for each quadrat was recorded. Quadrats were placed at 1 m intervals along each transect.

Surveys were conducted in March in order to estimate the number of individuals present prior to the flowering period. The number of plants present at this time were so numerous that only five randomly selected quadrats could be sampled within the time allotted. This does not represent 5% of the total area of all three subpopulations, however, it does provide a rough estimate of the individuals present. During the surveys conducted within the plants flowering period (May), 59 quadrats were sampled.

During the data collection process, every effort was made to avoid stepping on the sensitive plants. Only one person counted the plants to lower the amount of foot traffic where the plants were growing. The individual counting the plants made every attempt to step on rocks or other areas where plants would not be located. Another person recorded the data while remaining outside the area of occupied habitat to avoid additional impacts from trampling.

Crest Canyon

On the southern mesa of Crest Canyon, there were only a few, scattered individuals. Therefore, a complete census was done of all individuals found. The northern mesa is more isolated and had many more individuals (see attached map).

The northern mesa, located on a mesa behind houses on Lozana Road, was sampled using a organisms-to-nearest neighbor distance method (Byth and Ripley (1980) as cited in Krebs, 1998). This is a methodology for determining density that does not require any plots (i.e, plotless method). This method was explored as an alternative to the line-transect plot method that is described in the MSCP Monitoring Methodology for rare plants (Ogden, 1996). Concerns have been raised about the potential impacts to the species using the line-transect plot methodology

due to the intensity of sampling 5% of individual plants in a population.

The sampling methodology consisted of randomly selecting 75 individuals through out area occupied by the *Dudleya blochmaniae* ssp. *brevifolia* and measuring the distance to the nearest neighboring individual. This approach minimized the number of individuals impacted by counting. The results are as follows: Mean = 2629 individual, with a 95% confidence interval of the mean from 2561 - 2700 individuals.

This approach in practice is simple to use, but tends to overestimate the density of individuals that occur in a clumped or aggregated pattern. To compensate for this potential problem the inclusion of a density estimator is suggested (see Kerbs, 1998). This approach will be further explored next year.

Skeleton Canyon

A complete census was done for all individuals found within Skeleton Canyon (see attached map).

Torrey Pines State Park

The dudleya population at Torrey Pines State Park is quite large and sampling the population would involve a major work effort that could result in damages to the plant within the State Park jurisdiction. Therefore pursuant to discussions with State Park ecologist Dr. Michael Wells, sampling was not pursued at this site. However, the boundaries of the site were surveyed using a sub-meter GPS (see attached map).

Torrey Pines State Park Extension

A complete census was done for all individuals found within Torrey Pines State Park Extension (see attached map).

Results

Carmel Mountain

Data from the monitoring effort are shown on the attached monitoring data forms. It is estimated from the results of the transect method that approximately 66,637 individuals of short-leaved dudleya were found on Carmel Mountain in the year 2001. 23,656 of those individuals occur within subpopulation 1 (all flowering), 5,580 individuals occur within subpopulation 2 (all flowering), and 37,337 individuals occur within subpopulation 3, (flowering and non-flowering). 64 flowering individuals were counted through census within the new subpopulation. In comparison, approximately total 27,000 individuals were found on Carmel Mountain in 1999 and total 23,500 individuals in 2000 (Figure 1).

As part of the 2001 surveys, MSCP staff surveyed the boundaries of the subpopulations using a sub-meter GPS. This gave us a more accurate measurement of the size of the subpopulations. Subpopulation 1 on Carmel Mountain is 2,897 square feet in size, subpopulation 2 is 1,279 square feet in size, and subpopulation 3 is 5,107 square feet in size. The size of subpopulations 1 and 3 were overestimated in previous on the ground measurements conducted in 1999. In addition, the size of subpopulation 2 was underestimated.

During the 2001 surveys, subpopulation 3 appeared to have expanded in size by approximately 8,252 square feet. Due to time constraints, the expanded portion of subpopulation 3 was not sampled.

From sampling done prior to the flowering period, we estimated 116,746 individuals within subpopulation 1, 11,092 individuals within subpopulation 2, and 66,953 individuals within subpopulation 3. Seedlings, juveniles, and non-flowering adults were found during the March survey effort. It is important to note that due to time constraints, the sampling method used in March before the flowering period did not sample at least 5% of the population.

Comparing the March survey effort to the May survey effort, it appears that only 34% of the original population size survives to reach the flowering stage. It is presumed that 66% of the plants found before the flowering period underwent senescence before flowering. These means that approximately two-thirds of the plant population did not undergo the reproductive process during the 2001 survey year.

Crest Canyon

53 individuals were counted on the southern mesas of Crest Canyon. Since there were only a few scattered individuals on the southern mesa of Crest Canyon the square footage of the population could not be estimated. It is estimated from the results of the nearest neighbor method that approximately 2,629 individuals were on the northern mesa of Crest Canyon in 2001. The population on the northern mesa of Crest Canyon was measured to be 1327 square feet in size.

Skeleton Canyon

62 individuals were counted within Skeleton Canyon. The population within Skeleton Canyon is 360 square feet in size.

Torrey Pines State Park

A count was not conducted within Torrey Pines State Park. The western Torrey Pines State Park subpopulation is 38,887 square feet and the eastern Torrey Pines State Park subpopulation is 36,337 square feet.

Torrey Pines State Park Extension

101 individuals were counted within Torrey Pines State Park Extension. The Torrey Pines State Park Extension population is 505 square feet in size.

Conclusions

Most of the individuals observed were in flower, but a small number of non-flowering individuals were also found. Since short-leaved dudleya is a perennial species, one would expect to see more than one life-stage represented in a population/sampling area. Every effort was made to locate juvenile and non-flowering adults. The surveyors were visually familiar with all stages of the plants' growth.

Populations which occur along active trails systems appeared to be more sparse and impacted than other more isolated populations. Fences and active management appear to minimize impacts since there did not appear to be many impacts to the Torrey Pines State Park population which occurs directly along an active trail and is separated from the trail only by a split rail fence. Frequent ranger activity along the busy trail most likely helps keep people on the existing trail as well. In contrast, the dudleya along the southern mesa of Crest Canyon is also along well-used trail that is not fenced or monitored frequently by ranger staff. Therefore, many of the dudleya along that trail appear to be trampled and the individuals found were sparse and infrequent.

It appears that impacts to the population can be reversed if the impacts are removed. Access to Carmel Mountain has been greatly reduced since development has precluded access from many of the surrounding communities. Dudleya can now be found growing within the trails in higher numbers where individuals were previously sparse. However, additional surveys will need to be done in order to verify this trend. In addition, future residential development will increase pressure on the Carmel Mountain population as the area gets built out.

Recommendations

As mentioned above, every attempt was made to avoid stepping on the sensitive plants. However, impacts to the plants still may occur during monitoring, especially in the areas that contain a higher density of plant species. A different monitoring technique which would not require stepping over the plants would protect the plants from incidental impacts and make monitoring less difficult. Use of photography may be incorporated into the monitoring effort to determine if photographs can be used to determine plant numbers without running traditional transects. MSCP staff recommends that sampling of plants only be done at the Carmel Mountain site. Other sites would be surveyed for presence/absence but no sampling would occur. This would help reduce damage to the populations which may occur during monitoring and also better allocate time for monitoring other endangered plant species.

The sampling areas on Carmel Mountain should continue to be monitored to determine if the reduction in off-road vehicle use and other access will benefit the species overtime. Permanent transects should be placed in the expanded area of subpopulation 3 and the new population found

on the mesa adjacent to subpopulation 1 in order to allow sampling of these areas in the future. If population declines are seen within the next few years it may be necessary to prohibit equestrian use, mountain biking, and possibly hiking in the areas where the sampling areas are located. Barriers would need to be installed since many of the sampling areas occur along existing trails. Enhancement of dudleya populations may also be beneficial if it is determined over subsequent monitoring years that the populations can support additional individuals.

MSCP staff also recommends that sampling/census counting of plants only be done at the Carmel Mountain site for future surveys. Presence/absence surveys can be done at Crest Canyon, Torrey Pines, and Skeleton Canyon, noting any new disturbances or potential impacts each year. The Carmel Mountain site contains a significant population which can be sampled fairly easily and would provide MSCP staff with an indication of the status of the species. Presence/absence surveys are adequate to determine the annual status of the plant species at Crest Canyon, Torrey Pines, and Skeleton Canyon.

References

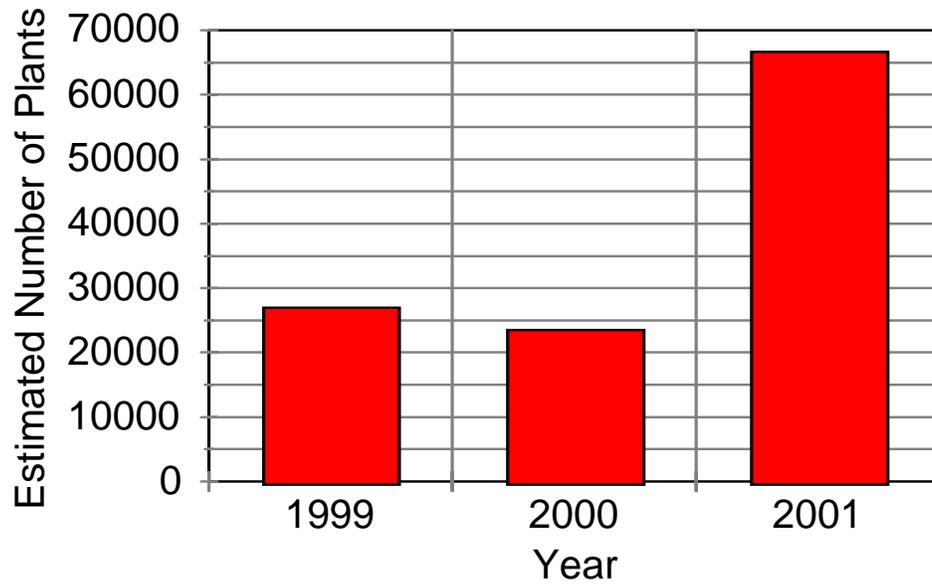
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Krebs, Charles J. *Ecological Methodology*. 2nd ed. Addison-Wesley Pub Co., 1998.

Ogden Environmental. *Biological Monitoring Plan for the Multiple Species Conservation Program*. 1996.

Figure 1

Carmel Mountain Short-leaved Dudleya Estimated Numbers 1999-2001



**DATA REDUCTION FORM
COVERED PLANT SPECIES MONITORING**

COVERED SPECIES Dudleya blochmaniae ssp. brevifolia
 MONITORING LOCATION Carmel Mountain Subpopulation 1
 TOTAL AREA SAMPLED 296 m²
 NUMBER OF TRANSECTS 6 TOTAL TRANSECT LENGTH 37.52 m
 NUMBER OF QUADRATS 17 TOTAL QUADRAT SIZE 17 m²

TRANSECT NUMBER	NUMBER OF PLANTS	AGE CLASSES ¹			
		SEEDLING	JUVENILE	ADULT FL	ADULT NFL
1	460			460	
2	187			187	
3	563			563	
4	271			271	
5	3			3	
6	11			11	
7					
8					
9					
10					
11					
12					
13					
14					
15					
N	6			6	
SUM	1495			1495	
MEAN	249.17			249.17	
STANDARD DEVIATION	17.29			17.29	
VARIANCE	299			299	

¹ADULT FL = ADULT FLOWERING; ADULT NFL = ADULT NONFLOWERING

**DATA REDUCTION FORM
COVERED PLANT SPECIES MONITORING**

COVERED SPECIES Dudleya blochmaniae ssp. brevifolia
 MONITORING LOCATION Carmel Mountain Subpopulation 2
 TOTAL AREA SAMPLED 118 m²
 NUMBER OF TRANSECTS 2 TOTAL TRANSECT LENGTH 15 m
 NUMBER OF QUADRATS 7 TOTAL QUADRAT SIZE 7 m²

TRANSECT NUMBER	NUMBER OF PLANTS	AGE CLASSES ¹			
		SEEDLING	JUVENILE	ADULT FL	ADULT NFL
1	149			149	
2	182			182	
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
N	2			2	
SUM	331			331	
MEAN	165.5			165.5	
STANDARD DEVIATION	18.19			18.19	
VARIANCE	331			331	

¹ADULT FL = ADULT FLOWERING; ADULT NFL = ADULT NONFLOWERING

**DATA REDUCTION FORM
COVERED PLANT SPECIES MONITORING**

COVERED SPECIES	<u>Dudleya blochmaniae ssp. brevifolia</u>		
MONITORING LOCATION	<u>Carmel Mountain Subpopulation 3</u>		
TOTAL AREA SAMPLED	<u>474 m²</u>		
NUMBER OF TRANSECTS	<u>11</u>	TOTAL TRANSECT LENGTH	<u>80.94 m</u>
NUMBER OF QUADRATS	<u>35</u>	TOTAL QUADRAT SIZE	<u>35 m²</u>

TRANSECT NUMBER	NUMBER OF PLANTS	AGE CLASSES ¹			
		SEEDLING	JUVENILE	ADULT FL	ADULT NFL
1	346			337	9
2	285			285	
3	135			135	
4	187			187	
5	17			17	
6	14			14	
7	135			128	7
8	240			240	
9	755			754	1
10	301			301	
11	342			342	
12					
13					
14					
15					
N	11			11	11
SUM	2757			2740	17
MEAN	250.64			249.09	0.65
STANDARD DEVIATION	16.60			4.99	1.30
VARIANCE	275.7			24.91	1.70

¹ADULT FL = ADULT FLOWERING; ADULT NFL = ADULT NONFLOWERING

**FINAL SUMMARY FORM
COVERED PLANT SPECIES MONITORING**

COVERED SPECIES Dudleya blochmaniae ssp. brevifolia
 MONITORING LOCATION Carmel Mountain Subpopulation 1
 MONITORING DATE March 23, 2001

I. POPULATION DENSITY

NUMBER OF INDIVIDUALS SAMPLED = 1302
 AREA SAMPLED = 3 m²
 NUMBER OF QUADRATS = 3

DENSITY OF AREA SAMPLED = $\frac{\text{NUMBER OF INDIVIDUALS}}{\text{AREA SAMPLED}} = \underline{434 \text{ individuals/m}^2}$

II. POPULATION SIZE

POPULATION SIZE = TOTAL AREA OF POPULATION X DENSITY
 = $\underline{269 \text{ m}^2} \times \underline{434} = \underline{116,746 \text{ individ.}}$

III. AGE CLASS STRUCTURE

AGE CLASS STRUCTURE = $\frac{\text{NUMBER OF QUADRATS IN WHICH THE AGE CLASS OCCURS}^1}{\text{TOTAL NUMBER OF QUADRATS SAMPLED}}$

SEEDLINGS	<u>100</u>	%
JUVENILES	<u>100</u>	%
FLOWERING ADULTS	<u>0</u>	%
NONFLOWERING ADULTS	<u>100</u>	%

NOTES: _____

¹Refer to field data collection form for number of quadrats in which each age class occurs and total the number of quadrats sampled.

**FINAL SUMMARY FORM
COVERED PLANT SPECIES MONITORING**

COVERED SPECIES Dudleya blochmaniae ssp. brevifolia
 MONITORING LOCATION Carmel Mountain Subpopulation 2
 MONITORING DATE March 23, 2001

I. POPULATION DENSITY

NUMBER OF INDIVIDUALS SAMPLED = 94
 AREA SAMPLED = 1 m²
 NUMBER OF QUADRATS = 1

DENSITY OF AREA SAMPLED = $\frac{\text{NUMBER OF INDIVIDUALS}}{\text{AREA SAMPLED}}$ = 94 individuals/m²

II. POPULATION SIZE

POPULATION SIZE = TOTAL AREA OF POPULATION X DENSITY
 = 118 m² X 94 = 11,092 individ.

III. AGE CLASS STRUCTURE

AGE CLASS STRUCTURE = $\frac{\text{NUMBER OF QUADRATS IN WHICH THE AGE CLASS OCCURS}^1}{\text{TOTAL NUMBER OF QUADRATS SAMPLED}}$

SEEDLINGS	<u>100</u>	%
JUVENILES	<u>100</u>	%
FLOWERING ADULTS	<u>0</u>	%
NONFLOWERING ADULTS	<u>100</u>	%

NOTES: _____

¹Refer to field data collection form for number of quadrats in which each age class occurs and total the number of quadrats sampled.

**FINAL SUMMARY FORM
COVERED PLANT SPECIES MONITORING**

COVERED SPECIES Dudleya blochmaniae ssp. brevifolia
 MONITORING LOCATION Carmel Mountain Subpopulation 1
 MONITORING DATE May 25, 2001

I. POPULATION DENSITY

NUMBER OF INDIVIDUALS SAMPLED = 1495
 AREA SAMPLED = 17 m²
 NUMBER OF QUADRATS = 17

DENSITY OF AREA SAMPLED = $\frac{\text{NUMBER OF INDIVIDUALS}}{\text{AREA SAMPLED}} = \underline{\underline{87.94 \text{ individuals/m}^2}}$

II. POPULATION SIZE

POPULATION SIZE = TOTAL AREA OF POPULATION X DENSITY
 = $\frac{269 \text{ m}^2}{17} \times 87.94 = \underline{\underline{23,656 \text{ individ.}}}$

III. AGE CLASS STRUCTURE

AGE CLASS STRUCTURE = $\frac{\text{NUMBER OF QUADRATS IN WHICH THE AGE CLASS OCCURS}^1}{\text{TOTAL NUMBER OF QUADRATS SAMPLED}}$

SEEDLINGS	<u>0</u>	%
JUVENILES	<u>0</u>	%
FLOWERING ADULTS	<u>100</u>	%
NONFLOWERING ADULTS	<u>0</u>	%

NOTES: _____

¹Refer to field data collection form for number of quadrats in which each age class occurs and total the number of quadrats sampled.

**FINAL SUMMARY FORM
COVERED PLANT SPECIES MONITORING**

COVERED SPECIES Dudleya blochmaniae ssp. brevifolia
 MONITORING LOCATION Carmel Mountain Subpopulation 2
 MONITORING DATE May 25, 2001

I. POPULATION DENSITY

NUMBER OF INDIVIDUALS SAMPLED = 331
 AREA SAMPLED = 7 m²
 NUMBER OF QUADRATS = 7

DENSITY OF AREA SAMPLED = $\frac{\text{NUMBER OF INDIVIDUALS}}{\text{AREA SAMPLED}} = \underline{47.29 \text{ individuals/m}^2}$

II. POPULATION SIZE

POPULATION SIZE = TOTAL AREA OF POPULATION X DENSITY
 = $\underline{118 \text{ m}^2} \times \underline{47.29} = \underline{5,580 \text{ individ.}}$

III. AGE CLASS STRUCTURE

AGE CLASS STRUCTURE = $\frac{\text{NUMBER OF QUADRATS IN WHICH THE AGE CLASS OCCURS}^1}{\text{TOTAL NUMBER OF QUADRATS SAMPLED}}$

SEEDLINGS	<u>0</u>	%
JUVENILES	<u>0</u>	%
FLOWERING ADULTS	<u>100</u>	%
NONFLOWERING ADULTS	<u>0</u>	%

NOTES: _____

¹Refer to field data collection form for number of quadrats in which each age class occurs and total the number of quadrats sampled.

**FINAL SUMMARY FORM
COVERED PLANT SPECIES MONITORING**

COVERED SPECIES Dudleya blochmaniae ssp. brevifolia
 MONITORING LOCATION Carmel Mountain Subpopulation 3
 MONITORING DATE May 25, 2001

I. POPULATION DENSITY

NUMBER OF INDIVIDUALS SAMPLED = 2757
 AREA SAMPLED = 35 m²
 NUMBER OF QUADRATS = 35

DENSITY OF AREA SAMPLED = $\frac{\text{NUMBER OF INDIVIDUALS}}{\text{AREA SAMPLED}} = \underline{78.77 \text{ individuals/m}^2}$

II. POPULATION SIZE

POPULATION SIZE = TOTAL AREA OF POPULATION X DENSITY
 = $\underline{474 \text{ m}^2} \times \underline{78.77} = \underline{37,337 \text{ individ.}}$

III. AGE CLASS STRUCTURE

AGE CLASS STRUCTURE = $\frac{\text{NUMBER OF QUADRATS IN WHICH THE AGE CLASS OCCURS}^1}{\text{TOTAL NUMBER OF QUADRATS SAMPLED}}$

SEEDLINGS	<u>0</u>	%
JUVENILES	<u>0</u>	%
FLOWERING ADULTS	<u>100</u>	%
NONFLOWERING ADULTS	<u>11</u>	%

NOTES: _____

¹Refer to field data collection form for number of quadrats in which each age class occurs and total the number of quadrats sampled.



Sampling Areas



MHPA

Carmel Mountain

Dudleya blochmaniae ssp. *brevifolia*

Survey Date: 3-23-01, 5-25-01

Source: H. Boessow, M. Doderer, J. Harry,
R. Rodriguez, M. Klein, I. Kay





 Sampling Areas

 MHPA



Crest Canyon

Dudleya blochmaniae ssp. *brevifolia*

Survey Date: 5-23-01, 6-4-01

Source: H. Boessow, K. Greer,
R. Rodriguez, J. Harry,
B. Williams, M. Klein



Survey Areas



MHPA

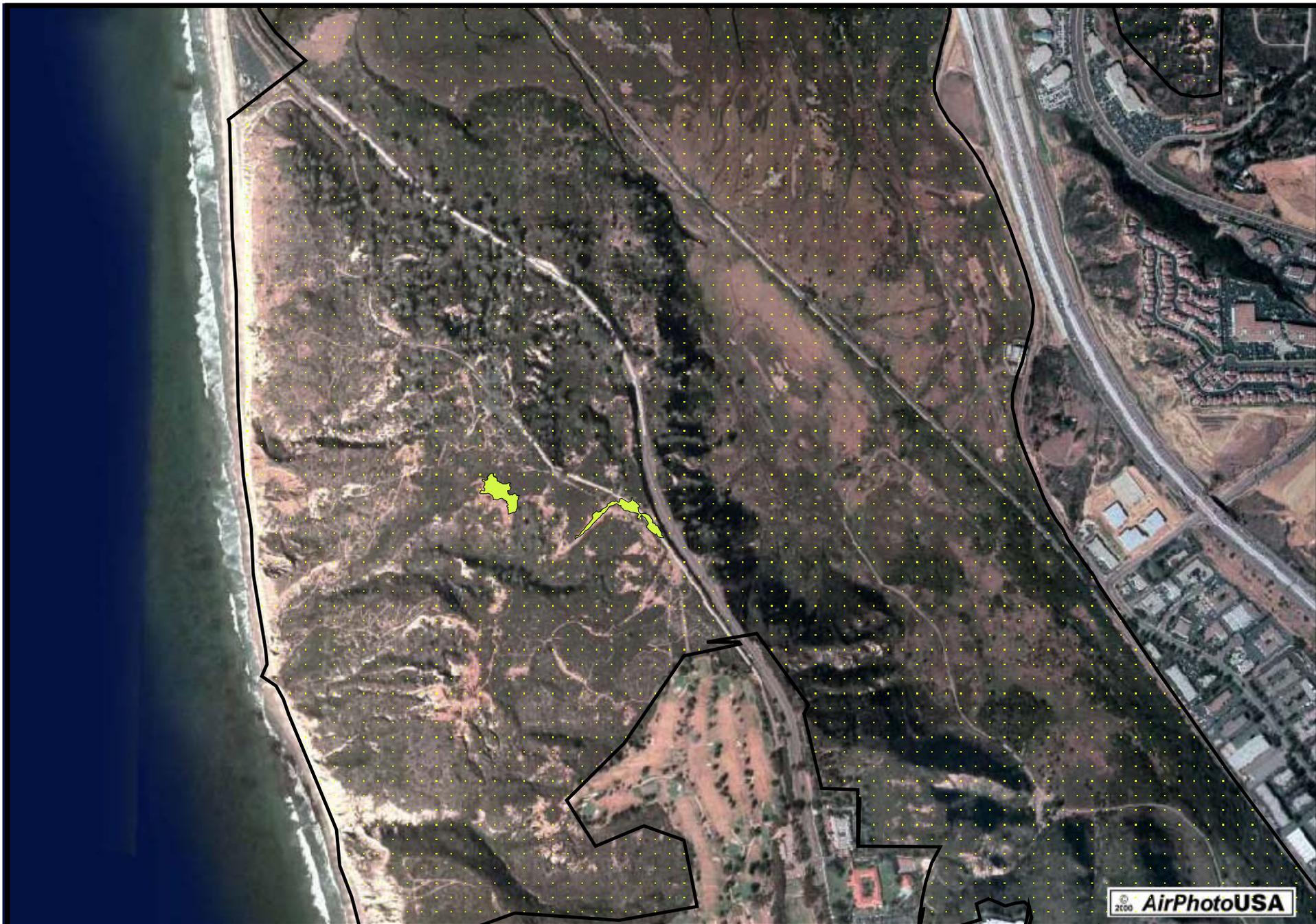
Skeleton Canyon Survey

Dudleya blochmaniae ssp. *brevifolia*

Survey Date: 5-23-01



Source: H. Boessow, K. Greer,
J. Harry, R. Rodriguez
M. Klein, I. Kay



2600 AirPhotoUSA



Survey Areas



MHPA

Torrey Pines State Reserve

Dudleya blochmaniae ssp. *brevifolia*

Survey Date: 5-23-01



Source: H. Boessow, K. Greer,
J. Harry, R. Rodriguez,
M. Klein, M. Wells



Survey Areas



MHPA

Torrey Pines Extension

Dudleya blochmaniae ssp. *brevifolia*

Survey Date: 5-23-01



Source: H. Boessow, K. Greer,
J. Harry, R. Rodriguez,
M. Klein, M. Wells