

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

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

**May 2002**

## 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
April 8, 2002	Torrey Pines State Park	Holly Cheong, Brett Williams, Jim Harry, Michael Klein
April 12, 2002	Skeleton Canyon	Holly Cheong, Brett Williams, Jim Harry
May 10, 2002	Carmel Mountain	Holly Cheong, Keith Greer, Jim Harry, Randy Rodriguez, Brett Williams, Chad Kane

## 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 and skeleton canyon was remapped during the 2002-monitoring season. For the smaller populations presence/absence surveys were conducted instead of a comprehensive census of the individuals. 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). In 2001, an additional subpopulation of small size was located on a mesa adjacent to subpopulation 1. 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

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 and string was run along the transect route. A one-meter square (1 m<sup>2</sup>) quadrat was used to define the quadrat boundary and estimate population size. The 1 m<sup>2</sup> quadrat was placed along the left side of the transect. Each plant located within the 1 m<sup>2</sup> quadrat was counted and the total number for each quadrat was recorded. Quadrats were placed at 1 m intervals along each transect.

In addition to sampling the permanent one-meter quadrats, staff conducted an assessment of a plotless sampling method referred to as the T-square sampling (see Krebs 1999 section 5.2.2). This method utilizes the distance between a random point within the sampling area and the nearest organism. A second distance is measured from the organism to its nearest neighbor outside of an imagery circle around the random point and the organism. This method was selected to determine if sampling could achieve similar estimates for the population density, be less harmful to the plants being sampled and be completed in a quicker time.

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

In 2002, presence/absence surveys were conducted for both the northern and southern mesas.

### Skeleton Canyon

In 2002, a presence/absence survey was conducted and the limits of the population were mapped using a sub-meter GPS unit.

### 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, in 2002 the boundaries of the site were surveyed using a sub-meter GPS (see attached map).

### Torrey Pines State Park Extension

The Torrey Pines State Park Extension was not surveyed during the 2002 monitoring season due to time constraints.

## **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 1,446 individuals of short-leaved dudleya existed on Carmel Mountain in the year 2002. 521 of those individuals occur within subpopulation 1 (flowering and non-flowering), 34 individuals occur within subpopulation 2 (all flowering), and 891 individuals occur within subpopulation 3, (flowering and non-flowering). In comparison, approximately total 27,000 individuals were found on Carmel Mountain in 1999, 23,500 individuals in 2000, and 66,637 in 2001 (See Attached).

As a pilot project, the Carmel Mountain subpopulation 3 was sampled both by permanent quadrats and the T-square sampling methods. For the pilot sampling, the extent of the subpopulation was determined using the same extent as that used for the permanent quadrat sampling (474 m<sup>2</sup>). Random points were established using a coin tossed within the sampling area along the entire extent of the study area. One person measured the distance to the nearest plant and its nearest neighbor as described above. Another person recorded the distances standing outside of the subpopulation. Two individuals collected sixty-five pairs of distances in 76 minutes.

Method	Permanent Quadrat Sampling	T-Square Distance Sampling
Mean (m <sup>2</sup> )	1.88 individuals	2.36 individuals
95% C.I. of Mean (low)	0.84 individuals	1.64 individuals
95% C.I. of Mean (high)	2.92 individuals	4.22 individuals
Estimate of Subpopulation Density using Mean	891 individuals	1118 individuals
Time – person minutes	236 minutes	148 minutes

While the mean density of the distance method is higher than then quadrat method, the 95% confidence interval of the means overlap, suggesting that the two techniques can result in similar, reliable estimates for the subpopulation. The distance method is about 40% faster than the quadrat method indicating that its use as an alternative bears further examination next year.

During the 2002 surveys, all populations seemed to have decreased significantly. This is most likely due to drought conditions that persisted through out the growing season.

## Crest Canyon

No individuals were found during the presence/absence surveys conducted during 2002. It was noted that a neighbor adjacent to the northern mesa, had installed an “invisible” dog fence and had patio furniture on the mesa. Park and Recreation staff contacted the resident and the encroachment was removed.

## Skeleton Canyon

The population within Skeleton Canyon was mapped as 193 square feet in size in 2002. As comparison, the 2001 population size was mapped at 360 square feet.

### Torrey Pines State Park

A count was not conducted within Torrey Pines State Park. The western Torrey Pines State Park subpopulation is 28,639 square feet and the eastern Torrey Pines State Park subpopulation is 30,907 square feet.

### **Conclusions**

The 2002 monitoring season saw significant declines in dudleya population sizes, in general. This is most likely the result of drought conditions that persisted through out the growing season. Due to the lack of any significant rainfall only a limited amount of dudleya emerged and produced flowers. The populations did not seem to have sustained any additional disturbances than from the previous years.

Populations that 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. In previous years, many of the dudleya along that trail appeared 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.

Several issues were raised by the distance sampling method. The use of a fixed size for estimating population density (474 m<sup>2</sup>) should be reexamined. The subpopulations expand and contract depending on annual variation. Each year the maximum extent of each of the populations should be recorded with a submeter GPS system. The amount of samples in either method should be examined to determine if enough of the subpopulation is being sampled in any given year. Finally, the length of time for estimating any trends should be explored to evaluate the current sampling effort. City staff has initiated discussions with the USGS- Biological Research Division to discuss these issues.

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 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 can be done at Crest Canyon, Torrey Pines, and Skeleton Canyon, noting any new disturbances or potential impacts each year.

## **References**

Byth, K. and B.D. Ripley. "On Sampling Spatial Patterns By Distance Methods."  
Biometrics 1980:36:279-284.

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

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

**DATA REDUCTION FORM  
COVERED PLANT SPECIES MONITORING**

COVERED SPECIES Dudleya blochmaniae ssp. brevifolia  
 MONITORING LOCATION Carmel Mountain Subpopulation 1  
 TOTAL AREA SAMPLED 296 m<sup>2</sup>  
 NUMBER OF TRANSECTS 6 TOTAL TRANSECT LENGTH 37.52 m  
 NUMBER OF QUADRATS 17 TOTAL QUADRAT SIZE 17 m<sup>2</sup>

TRANSECT NUMBER	NUMBER OF PLANTS	AGE CLASSES <sup>1</sup>			
		SEEDLING	JUVENILE	ADULT FL	ADULT NFL
1	22			16	6
2	0			0	0
3	4			3	1
4	4			4	0
5	0			0	0
6	0			0	0
7					
8					
9					
10					
11					
12					
13					
14					
15					
N	6			6	6
SUM	30			23	7
MEAN	5			3.83	1.17
STANDARD DEVIATION	2.45			2.14	1.18
VARIANCE	6			4.6	1.4

<sup>1</sup>ADULT 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 m<sup>2</sup>  
 NUMBER OF TRANSECTS 2 TOTAL TRANSECT LENGTH 15 m  
 NUMBER OF QUADRATS 7 TOTAL QUADRAT SIZE 7 m<sup>2</sup>

TRANSECT NUMBER	NUMBER OF PLANTS	AGE CLASSES <sup>1</sup>			
		SEEDLING	JUVENILE	ADULT FL	ADULT NFL
1	0			0	0
2	2			2	0
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
N	2			2	2
SUM	2			2	0
MEAN	1			1	0
STANDARD DEVIATION	1.41			1.41	0
VARIANCE	2			2	0

<sup>1</sup>ADULT 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 3  
 TOTAL AREA SAMPLED 474 m<sup>2</sup>  
 NUMBER OF TRANSECTS 11 TOTAL TRANSECT LENGTH 80.94 m  
 NUMBER OF QUADRATS 34 TOTAL QUADRAT SIZE 34 m<sup>2</sup>

TRANSECT NUMBER	NUMBER OF PLANTS	AGE CLASSES <sup>1</sup>			
		SEEDLING	JUVENILE	ADULT FL	ADULT NFL
1	5			4	1
2	6			6	0
3	6			6	0
4	8			8	0
5	0			0	0
6	0			0	0
7	8			8	0
8	9			9	0
9	12			12	0
10	7			7	0
11	3			3	0
12					
13					
14					
15					
N	11			11	11
SUM	64			63	1
MEAN	5.82			5.73	.09
STANDARD DEVIATION	2.53			2.51	.32
VARIANCE	6.4			6.3	.1

<sup>1</sup>ADULT 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 May 10, 2002

### I. POPULATION DENSITY

NUMBER OF INDIVIDUALS SAMPLED = 30  
 AREA SAMPLED = 17 m<sup>2</sup>  
 NUMBER OF QUADRATS = 17

DENSITY OF AREA SAMPLED =  $\frac{\text{NUMBER OF INDIVIDUALS}}{\text{AREA SAMPLED}} = \underline{1.76 \text{ individuals/m}^2}$

### II. POPULATION SIZE

POPULATION SIZE = TOTAL AREA OF POPULATION X DENSITY  
 = 296 m<sup>2</sup> X 1.76 = 521 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>35</u>	%
NONFLOWERING ADULTS	<u>17</u>	%

#### NOTES:

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<sup>1</sup>Refer 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 10, 2002

### I. POPULATION DENSITY

NUMBER OF INDIVIDUALS SAMPLED = 2  
 AREA SAMPLED = 7 m<sup>2</sup>  
 NUMBER OF QUADRATS = 7

DENSITY OF AREA SAMPLED =  $\frac{\text{NUMBER OF INDIVIDUALS}}{\text{AREA SAMPLED}} = \underline{\underline{.285 \text{ individuals/m}^2}}$

### II. POPULATION SIZE

POPULATION SIZE = TOTAL AREA OF POPULATION X DENSITY  
 = 118 m<sup>2</sup> X .285 = 34 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>29</u>	%
NONFLOWERING ADULTS	<u>0</u>	%

#### NOTES:

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<sup>1</sup>Refer 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 10, 2002

### I. POPULATION DENSITY

NUMBER OF INDIVIDUALS SAMPLED = 64  
 AREA SAMPLED = 34 m<sup>2</sup>  
 NUMBER OF QUADRATS = 34

DENSITY OF AREA SAMPLED =  $\frac{\text{NUMBER OF INDIVIDUALS}}{\text{AREA SAMPLED}} = \underline{1.88 \text{ individuals/m}^2}$

### II. POPULATION SIZE

POPULATION SIZE = TOTAL AREA OF POPULATION X DENSITY  
 = 474 m<sup>2</sup> X 1.88 = 891 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>35</u>	%
NONFLOWERING ADULTS	<u>6</u>	%

#### NOTES:

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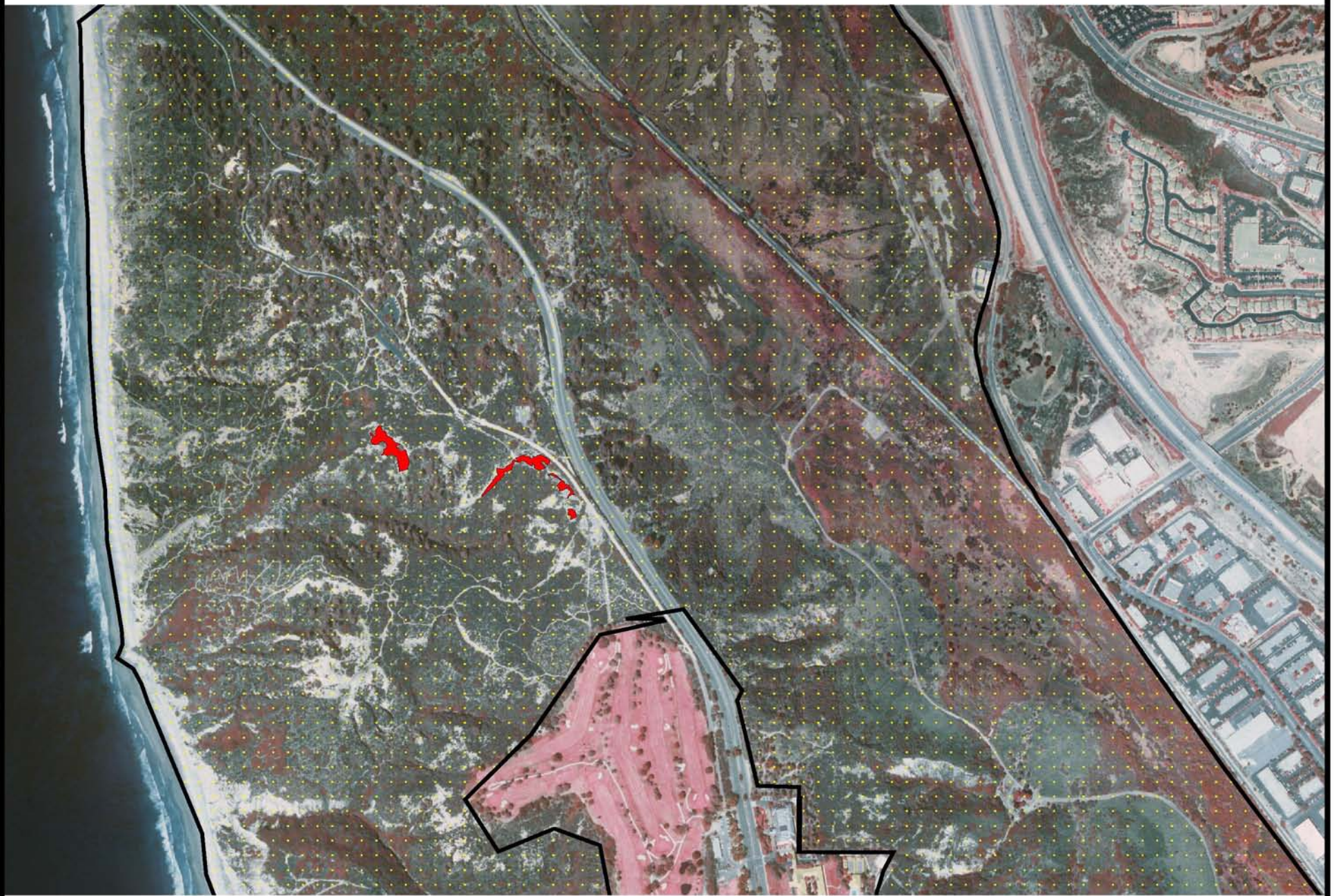
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<sup>1</sup>Refer to field data collection form for number of quadrats in which each age class occurs and total the number of quadrats sampled.



 Survey Areas

 MHPA

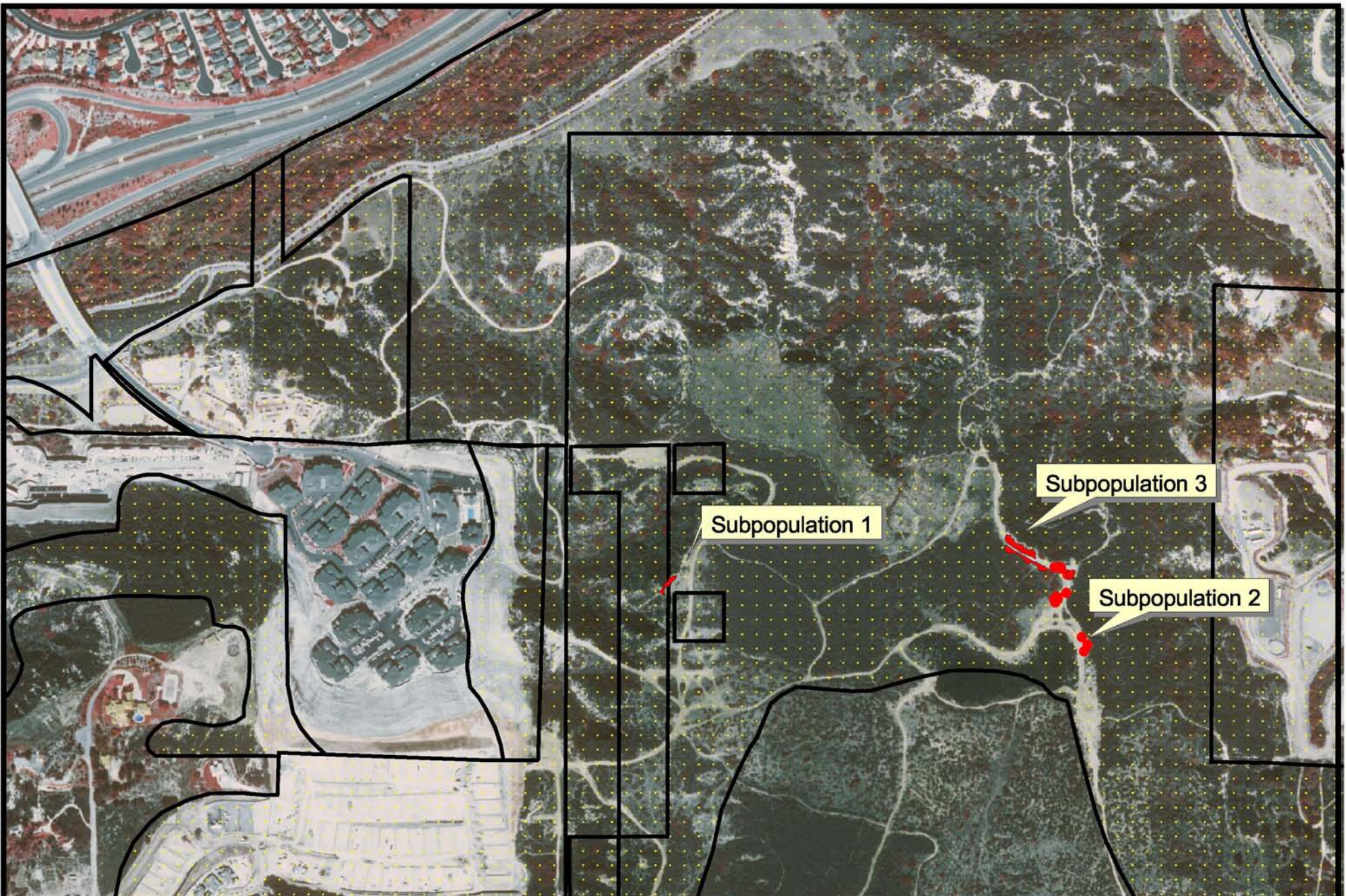
# Torrey Pines State Reserve

*Dudleya blochmaniae* ssp. *brevifolia*

Survey Date: 04-08-2002



Source: H. Cheong, B. Williams  
M. Klein, J. Harry



Subpopulation 3

Subpopulation 1

Subpopulation 2

- Sampling Areas
- MHPA

# Carmel Mountain

## *Dudleya blochmaniae* ssp. *brevifolia*

Survey Date: 5-10-02

Source: H. Cheong, B. Williams, J. Harry, R. Rodriguez, C.Kane





■ Survey Areas

▨ MHPA

# Skeleton Canyon Survey

*Dudleya blochmaniae* ssp. *brevifolia*

Survey Date: 4-12-02



Source: H. Cheong, B. Williams  
J. Harry