City of San Diego
Multiple Species Conservation Program

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

May 2003

Introduction

Short leaved dudleya (*Dudleya blochmaniae* ssp. *brevifolia*) is listed by the State of California as an endangered plant species. The only five known occurrences of this extremely rare plant in the City of San Diego 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
June 12, 2003	Torrey Pines State Park	Holly Cheong,
May 9, 2003	Skeleton Canyon, Crest Canyon	Holly Cheong, Melanie Johnson, Keli Balo
May 23, 2003	Carmel Mountain	Holly Cheong, Keith Greer, Melanie Johnson, Keli Balo, Gina Brown

Methodology

Monitoring for this species was conducted in accordance with the Biological Monitoring Plan for the Multiple Species Conservation Program (Monitoring Plan), dated January 25, 1996. Monitoring for this species began in 1999 on the Carmel Mountain site. In 2001, all survey sites were mapped using a sub-meter GPS. Each site was remapped during the 2002 and 2003 monitoring seasons.

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 occupied habitat area to avoid additional impacts from trampling.

For the smaller populations, presence/absence surveys were conducted instead of a comprehensive census of the individuals. With the exception of Torrey Pines State Park, the size of larger populations was estimated using transects and/or quadrats. The methodology is described by site below.

<u>Carmel Mountain</u>

Three separate sampling areas (subpopulations 1 through 3) were delineated on Carmel Mountain during the 1999 surveys (see attached map). In 2001, an additional subpopulation of small size

was located on a mesa adjacent to subpopulation 1. In 2003, another population was found adjacent to subpopulation 2. 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=55) 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 fixed transects were located and string was run along the transect route. A one-meter square (1 m^2) quadrat was used to define the quadrat boundary and estimate population size. The 1 m^2 quadrat was placed along the left side of the transect. Each plant located within the 1 m^2 quadrat was counted and the total number for each quadrat was recorded. Quadrats were placed at 1 m intervals along each transect.

The Carmel Mountain site subpopulation 3 was sampled using several distance methods: t-square sampling, ordered distance and point quarter (Krebs, 1998, pp. 173-184). These density-determining methods, which do not require plots (i.e., plotless methods), were explored as alternatives to the line-transect plot method 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 counting 5% of individual plants in the populations.

The sampling methodology consisted of systematically selecting random points (N=60) throughout the area of subpopulation 3 occupied by the *Dudleya blochmaniae* ssp. *brevifolia* and measuring the distance to the nearest neighboring individual. Individuals were selected randomly within systematic belts of ten feet by using a random number generator. Within a belt, two random numbers were generated to determine the length (x) and depth (y) of the random points. Distance was then measured to the nearest neighboring plant (t-square), the third nearest neighboring plant (ordered distance method), and the nearest plants in each of the ordinal quarters (point-quarter) from the random point. This approach was intended to minimize the number of individuals impacted by traditional transect counts by having to handle less individuals. This method is simple to implement, 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 Krebs, 1998, p. 183).

As recommended in previous years, quadrats within subpopulation 3 were also photographed using a digital infrared camera. The imagery was then enhanced to clearly show dudleya individuals within the quadrat.

Crest Canyon

In 2003, all plants within Crest Canyon on the southern mesa were counted. For the northern mesa, quadrats were randomly allocated using points on the GPS and navigated to. Four

quadrats were counted within the northern mesa area. The limits of the populations on both mesas were mapped using a sub-meter GPS.

Skeleton Canyon

In 2003, all plants within Skeleton Canyon were counted. The limits of the population were mapped using a sub-meter GPS.

Torrey Pines State Park

Due to the large population size at this site, 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 Ronnie Clark, sampling was not pursued at this site. However, in 2003 the boundaries of the site were surveyed using a sub-meter GPS (see attached map).

Torrey Pines State Park Extension

The limits of this population were mapped using a sub-meter GPS. However, to avoid impacts to the population, the number of individuals were not counted or estimated.

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 113,134 individuals of short-leaved dudleya were on Carmel Mountain in 2003. Of those individuals, 36,429 occur within subpopulation 1 (flowering and non-flowering), 22,274 individuals occur within subpopulation 2 (all flowering), and 54,431 individuals occur within subpopulation 3, (flowering and non-flowering). In comparison, approximately 27,000 individuals were found on Carmel Mountain in 1999, 23,500 individuals in 2000, 66,637 in 2001, and 1,446 in 2002. Results from the last five years of monitoring are given in Table 1 below.

Table 1: Subpopulation and Population Estimates for Carmel Mountain and Rainfall by Year

	1999	**2000**	**2001**	**2002**	**2003**
Subpopulation 1	10,024	11,385	23,656	521	36,429
Subpopulation 2	493	1,566	5,580	34	22,274
Subpopulation 3	16,800	10,536	37,337	891	54,431
Total Population Estimate	27,317	23,487	66,637	1,446	113,134
Rainfall (inches) October – June*	6.5	5.7	8.6	3.0	10.4

*Source: http://meteora.ucsd.edu/wx_pages/climatology.html

Subpopulation 3 was estimated using the distance methods described in the Methodology section above. The point-to-organism distance method resulted in a population estimate of 1,586 individuals (mean plants per $m^2 = 2.36$). The organism to nearest neighbor distance method resulted in a population estimate of 1,210 individuals (mean plants per $m^2 = 1.80$). The distance methods tested all resulted in significantly different estimates for population density. The largest values resulted from the line-quadrat method. The various distance methods resulted in values for less than the line-quadrat method. Further research is needed to evaluate why this considerable discrepancy is occurring. Based on the inconsistent results achieved, it is unlikely that these distance methods will be used in future short-leaved dudleya surveys.

As mentioned in the methodology section above, subpopulation 3 quadrats were photographed with a digital infrared camera. The images were enhanced to clearly distinguish the dudleya from the surrounding soil, rocks, and other plants. However, the pictures did not capture the entire quadrat and could not be compared to the counts conducted in the field.

During the 2003 surveys, all populations seemed to have increased significantly. Drought conditions in 2002 were probably the cause of low numbers for that year. Rainfall amounts returned to normal in 2003, and plant numbers increased dramatically. This suggests that dudleya is significantly affected by rainfall. Also, the population number tends to vary greatly from year to year.

Given the variable numbers of this species from year to year, MSCP staff evaluated the number of years it would take to be able to detect a significant difference in the population using the US Geological Service (USGS) online computer program called Monitor. Given the results from the past five years of monitoring on the Carmel Mountain site, it was calculated that five years of surveys would have a 62% chance of correctly detecting a 10% population increase, a 73% chance of correctly detecting a 10% population decrease, and 53% chance of detecting no change in the population. Monitor also determined that after additional five years of surveys (ten years total) using the transect/quadrat method, surveyors would have a 86% chance of correctly detecting a 10% population increase, a 100% chance of correctly detecting a 10% population decrease, and 46% chance of detecting no change in the population.

Crest Canyon

A total of 120 individuals were counted on the southern mesa of Crest Canyon in 2003. All individuals found were non-flowering. No individuals were found in 2002, while 53 flowering individuals were found on the southern mesa in 2001.

On the northern mesa, the population size was estimated to be 12,825 individuals. All individuals observed were non-flowering. In 2002, dudleya was not observed. In 2001, the population size was estimated to be 2,629 individuals using the organisms-to-nearest neighbor distance method. Given that randomly allocated quadrats were used to estimate the population in 2003 and the organisms-to-nearest neighbor distance method (which may be unreliable for this species) was used in 2001, it is unlikely that the population estimates from these two years are comparable.

Skeleton Canyon

A total of 191 individuals were counted in Skeleton Canyon in 2003. All individuals found were non-flowering. No individuals were found in 2002, while in 2001, 62 flowering individuals were counted.

Torrey Pines State Park

A count was not conducted within Torrey Pines State Park. The populations were mapped using a submeter GPS. The western Torrey Pines State Park subpopulation was 31,211 square feet in 2003 and the eastern Torrey Pines State Park subpopulation was 46,585 square feet in 2003. Many small subpopulations appeared in the area surrounding the eastern population and were included within the square footage of that population.

Torrey Pines Extension continues to support a small population of short-leaved dudleya. In 2003, the extension population measured 270 square feet in size.

Conclusions

The 2003 monitoring season showed increased numbers of short-leaved dudleya within the City of San Diego in contrast to the general declines in dudleya population sizes noted in 2002. This was most likely the result of drought conditions that persisted throughout that growing season and, due to the lack of significant rainfall, only a limited amount of dudleya emerged and produced flowers in 2002. Short-leaved dudleya numbers demonstrated recovery during 2003—an average rainfall year—from the previous drought.

Short-leaved dudleya flowered from late May into June during the 2003 monitoring season. Flowering during the 2002 monitoring season was documented during earlier months, probably as a result of the drought conditions. Due to scheduling limitations, Crest Canyon and Skeleton Canyon were monitored in early May before the species began to flower. This may affect the comparability of results since our 2001 surveys suggest a greater percentage of non-flowering individuals, which are more easily overlooked, early in the season (e.g., March, April).

Digital infrared photography with enhanced images appears to clearly distinguish between short-leaved dudleya and other surrounding features/plants. Although this method requires the photographer to step into the population, the length and intensity of impact is decreased because individuals are counted from the photographs at a later date. This methodology could be explored as a possible option to reduce impacts to the species associated with monitoring.

Populations that occur along active trails systems showed evidence of impacts and appeared to be sparser than more isolated populations. However, fences and active management appear to minimize impacts. There did not appear to be extensive impacts to the Torrey Pines State Park population which is separated from a busy, active trail only by a split rail fence. Frequent ranger activity encourages people to stay on the existing trail as well. In contrast, the dudleya along the

southern mesa of Crest Canyon borders a high traffic, unfenced trail. In previous years, many of the dudleya along that trail appeared to be trampled and the individuals found were sparse and infrequent.

Our data suggest that negative effects 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 are needed to verify this trend. In addition, future residential development is expected to increase pressure on the Carmel Mountain population.

Based on the results from Monitor (USGS), additional monitoring over time will increase the accuracy of change detection in the population trends at Carmel Mountain. Although population increases are more likely to be detected than population decreases, a greater number of monitoring years will not increase the probability of detecting no change in the population (see results above).

Recommendations

As mentioned above, every attempt was made to avoid trampling individuals. However, impacts to the plants still may occur during monitoring, especially in areas of higher population density. Alternative monitoring techniques which do not require stepping over the plants would protect against incidental impacts and decrease the difficulty of monitoring. Use of photography as an alternative monitoring method should continue to be explored.

The sampling areas on Carmel Mountain should continue to be monitored to determine if the reduction of off-road vehicle use and other access will benefit the species over time. New transects can be placed in areas of population expansion in order to allow sampling of these areas in the future. However, current transect locations should remain to ensure that results are comparable from year to year and to determine trends within the population. If population declines are detected in upcoming 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. If continued monitoring efforts suggest that the habitat can support additional individuals, enhancement of dudleya populations may also be beneficial.

MSCP staff recommends that sampling of plants be done exclusively 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. Presence/absence surveys can be done at Crest Canyon, Torrey Pines, and Skeleton Canyon, noting any new disturbances or potential impacts each year. Presence/absence surveys, along with census counts at the smaller populations, are adequate to determine the annual status of the plant species at Crest Canyon, Torrey Pines, and Skeleton Canyon. The Carmel Mountain site contains a significant population

which can be sampled fairly easily and would provide MSCP staff with an indication of the species status'.

References

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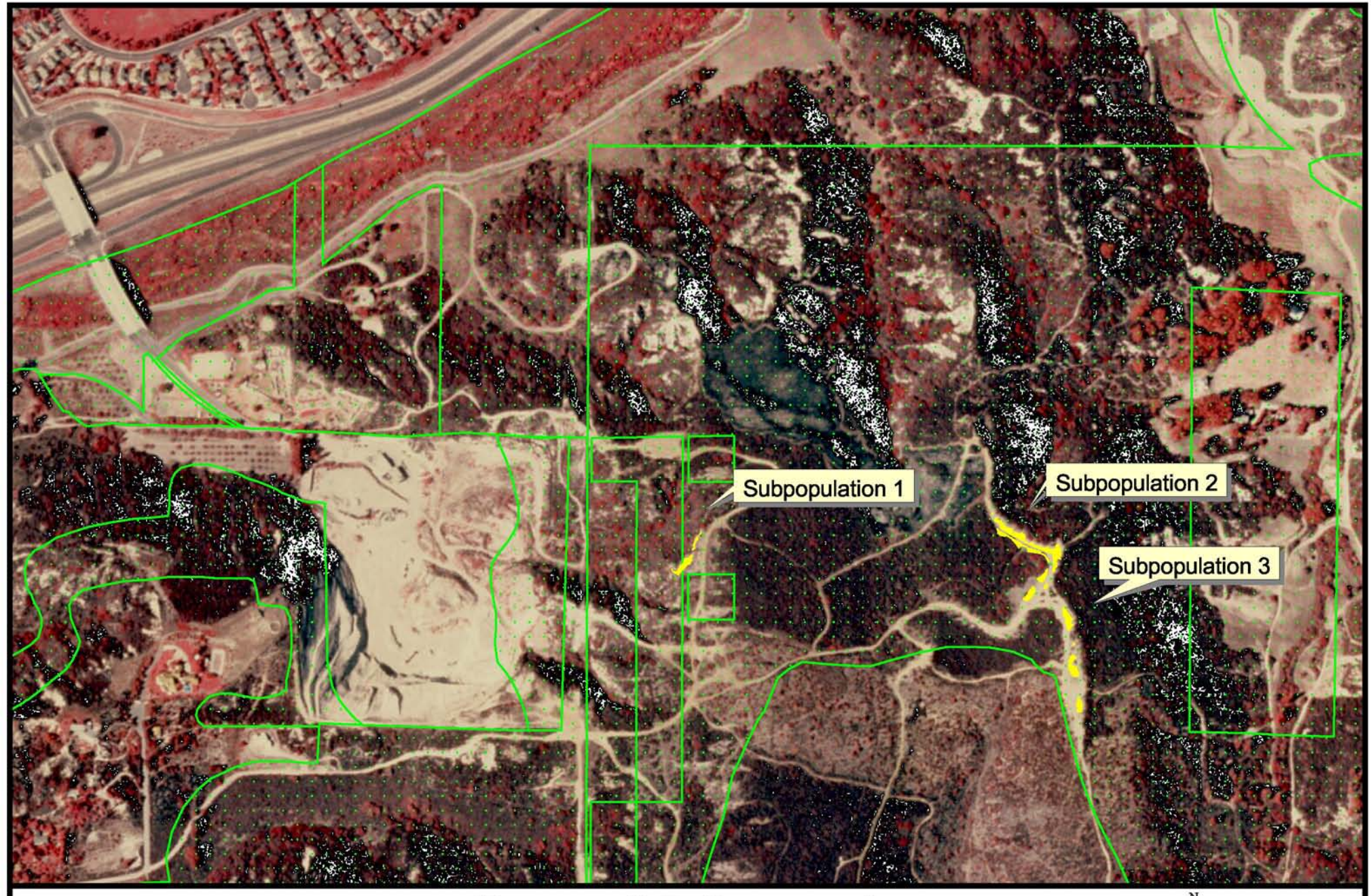


Sampling areas

MHPA

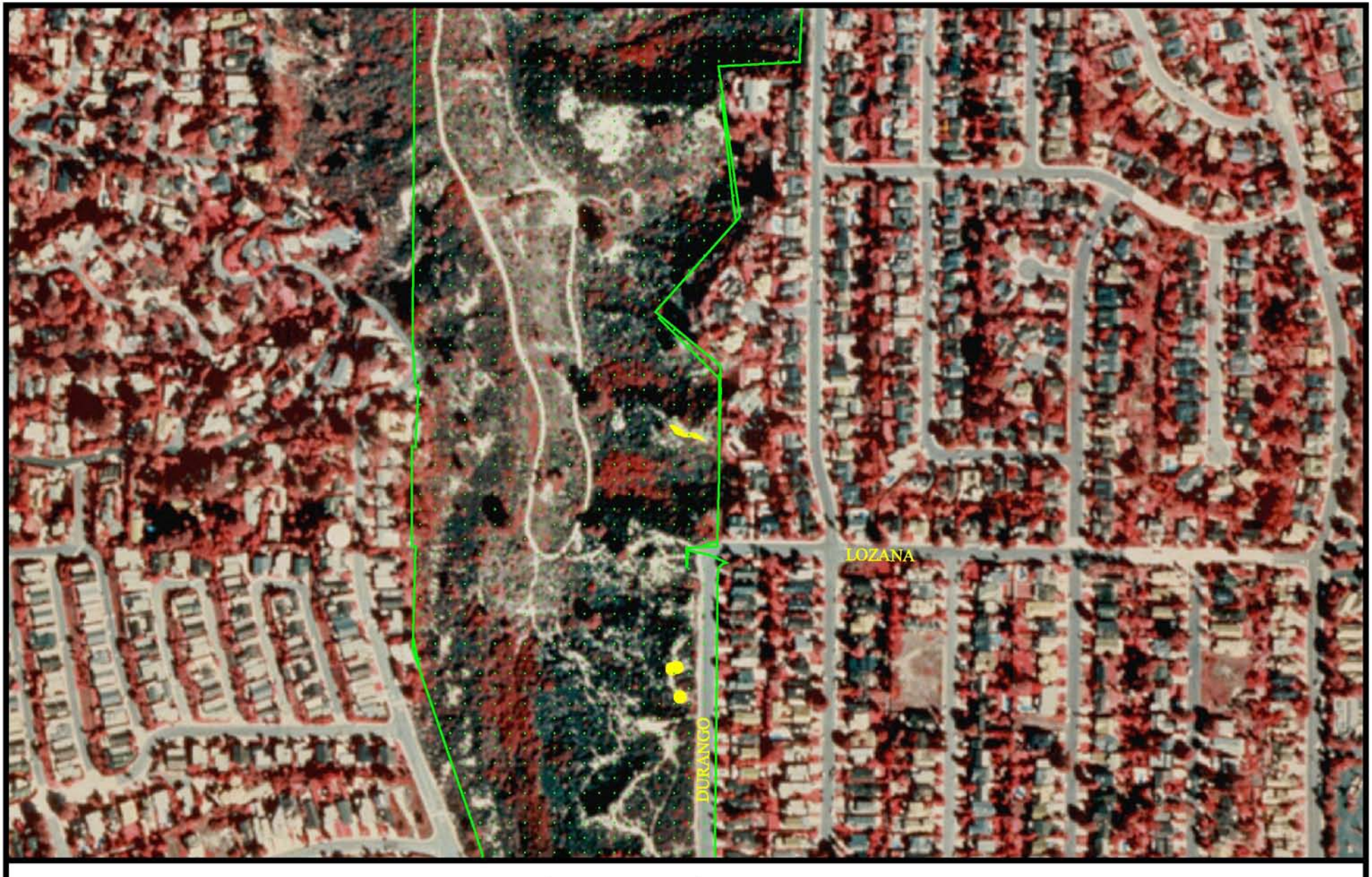
Carmel Mountain

Dudleya blochmaniae ssp. *brevifolia*

Survey Date: 5/23/03

N

Source:
H. Cheong, R. Rodriguez, K. Greer,
K. Balo, M. Johnson, G. Brown



Crest Canyon

Dudleya blochmaniae ssp. *brevifolia*

Sampling Areas

MHPA

Survey Date: 5/9/03

N

Source: H. Cheong, B. Miller
M. Johnson, K. Balo

Survey Areas

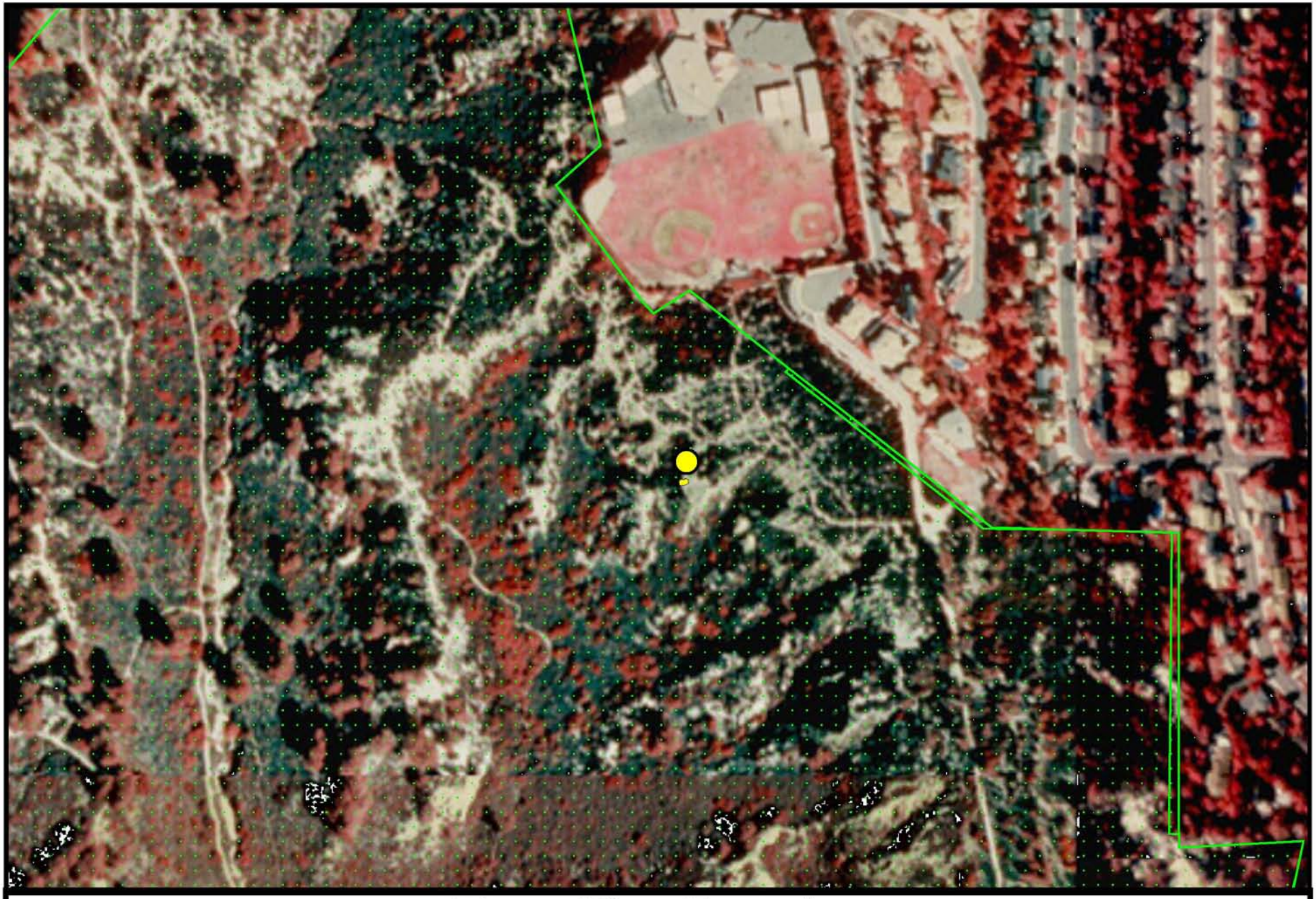
Skeleton Canyon

Dudleya blochmaniae ssp. *brevifolia*

Survey Date: 5/9/03

N

Source: H. Cheong, K. Balo
B. Miller, M. Johnson



Survey Areas

MHPA

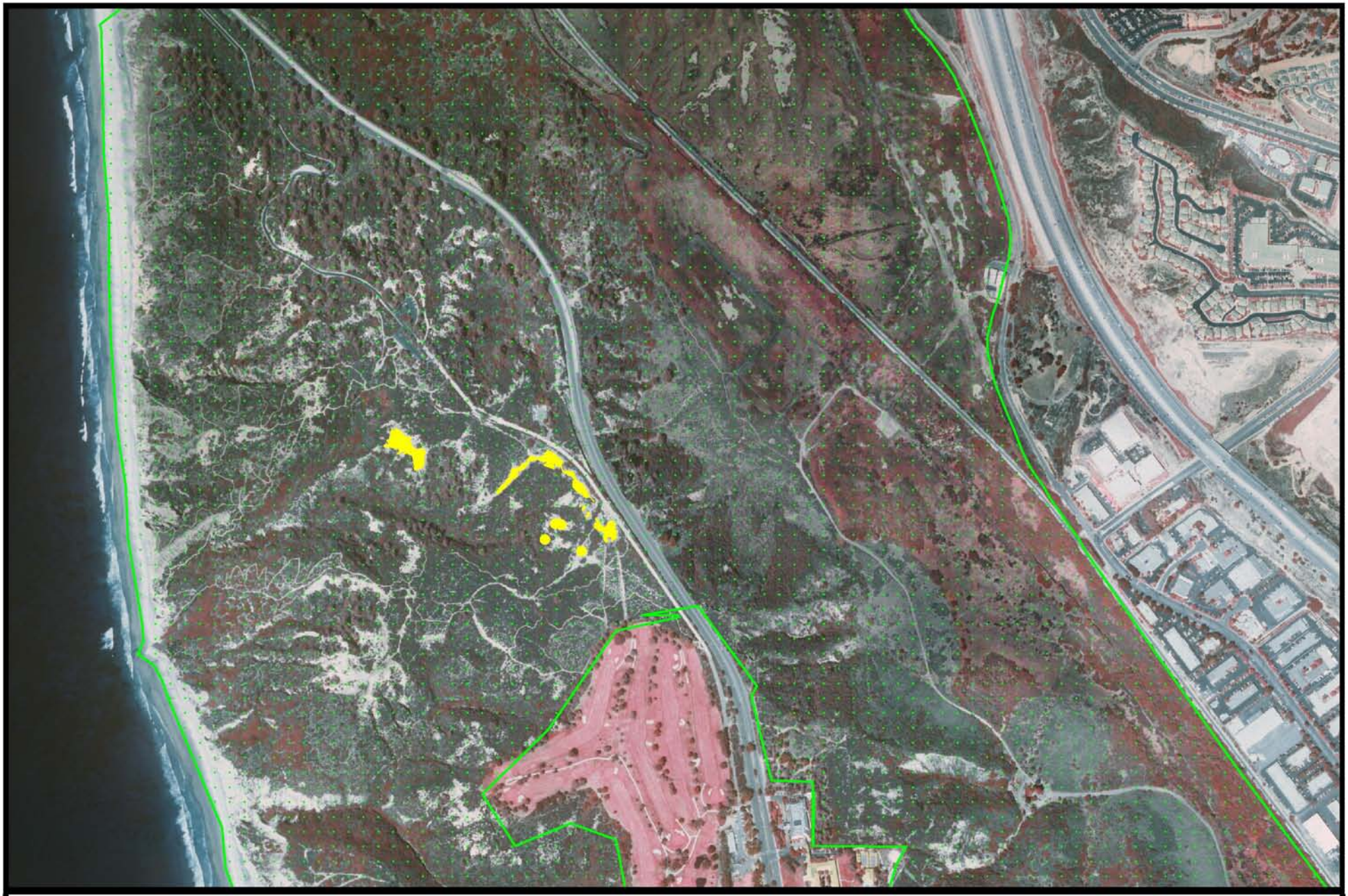
Torrey Pines Extension

Dudleya blochmaniae ssp. *brevifolia*

Survey Date: 5-23-03

N

Source: H. Cheong



Survey Areas

MHPA

Torrey Pines State Reserve

Dudleya blochmaniae spp. *brevifolia*

Survey Date: 06-12-2003

N

Source: H. Cheong