# *Dudleya verityi* (Verity's Dudleya)

# 5-Year Review: Evaluation and Summary

Photo: Adam Searcy, California Native Plant Society

**U.S. Fish and Wildlife Service**
**Ventura Fish and Wildlife Office**
**Ventura, California**

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# *Dudleya verityi* (Verity's Dudleya)

## 5-Year Review: Evaluation and Summary

**GENERAL INFORMATION:**

**Species:** *Dudleya verityi*
**FR citation:** 62 FR 4172
**Date listed:** 29 January 1997
**Classification:** Threatened

**BACKGROUND:**

**Most recent status review:**
U.S. Fish and Wildlife Service. 2009. *Dudleya verityi* (Verity's Dudleya) 5-Year Review: Summary and Evaluation. Ventura Fish and Wildlife Office. Ventura, California.

**FR Notice citation announcing this status review:**
Initiation of 5-Year Status Reviews of 40 Species in California, Nevada and Oregon. Notice of initiation of reviews; request for information. (87 FR 5832), 22 February 2022.

**Critical Habitat Designation:**
*Dudleya verity*i critical habitat has not been designated.

**State and Local Listing:**
*Dudleya verity*i has a California Rare Plant Rank of 1B.2 (California Natural Diversity Database [CNDDB] 2023, p.59). It is considered to be a locally important plant by Ventura County (Ventura County Planning Division 2022, p. 21).

**Recovery Plan:**
Service. 1999. Recovery Plan for Six Plants from the Mountains Surrounding the Los Angeles Basin. Portland, Oregon. 67 pp.

**ASSESSMENT:**

**Information acquired since the last status review:**
The U.S. Fish and Wildlife Service (Service), Ventura Fish and Wildlife Office conducted this 5-year review. The Service announced this review through a Federal Register notice on February 2, 2022 (87 FR 5832). We also contacted species experts to request any data or information we should consider in our review. Additionally, we conducted a literature search and a review of information in our files.

**Introduction:**
*Dudleya verityi* (Crassulaceae) occurs in the western Santa Monica Mountains of Ventura County, California (California Department of Fish and Wildlife [CDFW] 2023), with all occurrences bounded by a rectangular area of about 10 kilometers (km) by 3 km (6 miles [mi] by

2 mi). The species is a succulent perennial forb and occurs on volcanic rock faces where lichen substrate (*Niebla* spp.) is available for recruitment and growth (Riefner et al. 2003, p. 5). Individual plants can also expand clonally. *D. verityi* hybridizes with *Dudleya lanceolata* and *Dudleya blochmaniae* subsp. *blochmaniae*, and likely hybrids occur in some areas (Dorsey et al. 2013, pp. 58 and 65; Guilliams and Hasenstab-Lehman 2020, pp. 34-36).

**Distribution:**
At the time of listing in 1997 (Service 1997), there were 3 known occurrences of *D. verityi*. This number is now increased to a total of 8 CNDDB Element Occurrences ([EO] Table 1, CDFW 2023), and one possible unassigned occurrence (Dorsey et al. 2013, p. 61). An EO is a group of plants separated by at least 400 meters (1/4 mi) from the closest group of plants of the same species (CNDDB 2018, entire).

**Table 1.** Occurrences of *Dudleya verityi*, with crosswalks to occurrence identification numbers used in previous studies. Data are from CDFW 2023; Service 2009, p.7; and Dorsey et al. 2013, p. 61. CSU = California State University Channel Islands, MRCA = Mountains Recreation and Conservation Authority, COSCA = Conejo Open Space Conservation Agency, NPS = National Park Service, VCFCD = Ventura County Flood Control District.

| CNDDB EO ID # | Location | Last Year Seen | Site Owner | 2009 5-yr Review ID # | Dorsey et al. 2013 ID # | Notes |
|---|---|---|---|---|---|---|
| 1 | Long Grade Cyn, ridge above CSU | 2021 | CSU, private | EO1 | EO1, Sagar 05, NPS DUVE 101 | hybrids present |
| 2 | Water Treatment Plant/Quarry, west slope Conejo Mtn | 2021 | VCFCD, private | EO2 | EO2 | |
| 3 | North base Conejo Mtn | 2003 | private | 4 | Sagar 04?, NPS DUVE 4 | may have been a previous EO# 4 |
| 4 | Long Grade Cyn East | 1960 | private | none | none | may be part of EO# 1 |
| 5 | Dos Vientos | 2003 | MRCA, COSCA, private | 5 | Sagar 07 | |
| 6 | Airfield | 2021 | CSU | 6 | Sagar 06, NPS DUVE 103 | |
| 7 | Round Mtn | 2003 | CSU | 7 | Sagar 09, NPS DUVE 201 | possibly hybrid swarm with *Dudleya lanceolata* |
| 8 | Howard/Lewis Rds | 2003 | MRCA | 8 | Sagar 08 | |
| unassigned | Northeast base Conejo Mtn | 2010? | private | EO3 | Sagar 03? | may be part of E0# 3 |

The increase in the number of occurrences since listing was recognized in the Service 2009 5-year review and in Dorsey et al. 2013, but at the time of these publications CNDDB EO numbers had not yet been assigned to all of them. This resulted in different identification numbers being used for the same occurrences among the publications that differ somewhat from the current CNDDB EO numbers. We cross-walked the identification numbers in Table 1 above.

Eight of nine occurrences are known since at least 2003, and it is unlikely that additional occurrences will be found beyond the small, known geographic range of the species. We presume that all the occurrences are currently extant (CDFW 2023). More than half of the occurrences are partially or fully on private land, with limited or no access for surveys.

Several of the occurrences are relatively close to adjacent occurrences and may be merged in the future, particularly EO# 1 and EO# 4, and EO# 3 and the unassigned occurrence also on Conejo Mountain. The areas between these occurrences are on private land and not available for survey. EO# 1 has a range of hybrids between *D. verityi* and *D. lanceolata* as well as pure *D. verityi* (Guilliams and Hasenstab-Lehman 2020, pp. 34-36). EO# 5 may contain only hybrid plants between the two species (Dorsey et al. 2013, pp. 58 and 65), but no genetic analysis of the EO# 5 occurrence has been conducted. We discuss hybridization further in the threats section below.

**Abundance:**
Information about total population size for *D. verityi* was not given when we listed the species (Service 1997). Most of the occurrences and individuals are at least partially on private land, and have limited or no accessibility for surveys. Botanists surveyed at least parts of most of the occurrences in 2003, and estimated that the species had a total of approximately 15,000 individuals (Table 2). This is the most comprehensive data regarding *D. verityi* abundance available.

Three occurrences (EO# 1, EO# 2, and EO# 6) had population surveys in the same three years- 2003, 2010, and 2021. It is unknown how similar survey efforts were between years. Each of these occurrences had decreasing numbers of plants from 2003 to 2010, with total numbers of 13,450 in 2003 and 3,479 in 2010 (Table 2). These occurrences were also visited immediately after the 2013 Springs Fire burned over all occurrences of the species, causing severe mortality estimated at over 90% of the known individuals of the species (CNDDB 2023). The 2013 post-fire count was described as a "brief visit", and there was a total of only about 10 plants visible among these three occurrences (Dorsey et al. 2013, p. 66). Numbers of plants were not given for each separate occurrence, and CNDDB (2023, not included in Table 2 below) reports this total only as 11-50 plants for EO# 2, without giving numbers for EO# 1 or EO# 6. It is likely that at that time there were individuals which had the leaves burned off and were still alive but undetected. Botanists conducted a 2021 survey of the same three occurrences (EO# 1, EO# 2, and EO# 6), and found a total of 1,016 plants. Because of the decrease in numbers between 2003 and 2010 and the continued effects of the Springs Fire, all occurrences are characterized by CNDDB as decreasing (CDFW 2023).

**Table 2.** Abundance of *Dudleya verityi*. Data are from CDFW 2023, Dorsey et al. 2013, p. 61.; Service 2022a.

| CNDDB EO Number | Year Surveyed | Number of Plants | Survey Extent | Site Owner |
|---|---|---|---|---|
| 1 | 1987 | 1,000s | partial survey | CSU, private |
| | 2003 | 2,700 | partial survey | |
| | 2010 | 1,400+ | partial survey | |
| | 2021 | 6 | partial survey | |
| 2 | 2003 | 10,000 | entire site | VCFCD, private |
| | 2006 | 1,000s | partial survey | |
| | 2010 | 1,538 | partial survey | |

| CNDDB EO Number | Year Surveyed | Number of Plants | Survey Extent | Site Owner |
|---|---|---|---|---|
| | 2015<br>2021 | 30+<br>1,000 | partial survey<br>unknown | |
| 3 | 1980s<br>2003 | present<br>present | unknown<br>unknown | private |
| 4 | 1960 | present | unknown | private |
| 5 | 2003 | 1,500 | unknown | MRCA, COSCA, private |
| 6 | 2003<br>2010<br>2021 | 750<br>541<br>10 | entire site<br>partial survey<br>unknown | CSU |
| 7 | 2003 | 50 | unknown | CSU |
| 8 | 2003 | present | unknown | MRCA |
| unassigned | 2010? | present | unknown | private |

**Conservation Seed Banking:**
There are currently five accessions from three occurrences of *D. verityi* seed stored at the California Botanic Garden, which is a Center for Plant Conservation (CPC) approved conservation seed bank (Table 3, California Plant Rescue 2023). None of these accessions are by maternal line, (meaning that they were not collected and tracked from one or more individual plants), so we are unsure of their relatedness and genetic origins. The most recent accession is almost 20 years old, and the oldest is more than 40 years old. Seed longevity is unknown for *D. verityi*, but other species have germinated after 20 years of refrigerated storage (K. Niessen pers. obs.). Currently, the Santa Monica Mountains National Recreation Area and the Santa Barbara Botanic Garden have Service funding to expand the number of accessions in conservation seed banks (Service 2022a, 2022b).

**Table 3.** *Dudleya verityi* conservation seed banking. All seeds are bulk collected, and all seeds are stored at California Botanic Garden (California Plant Rescue 2023).

| CNDDB EO # | Collection Date | Location Description | Seeds (count) |
|---|---|---|---|
| 1 | 7/11/1989 | Long Grade Cyn Ridge above CSU | 22,175 |
| 2 | 8/23/1993 | Water Treatment Plant | 6,060 |
| 2 | 7/17/2006 | Water Treatment Plant | 5,488 |
| 3 | 6/13/1989 | North Base Conejo Mtn | 80,075 |
| 3 | 8/1/1991 | North Base Conejo Mtn | 733,466 |

**Genetics and Taxonomy:**
*D. verityi* appears to hybridize with *D. lanceolata*, and the hybrids appear to be both morphological and ecological intermediates between the parent species (Guilliams and Hasenstab-Lehman 2020, pp. 34-36). Researchers noted hybrids for Round Mountain (EO# 5, Dorsey et al. 2013, pp. 58 and 65), and for the ridge above the California State University, Channel Islands campus (EO# 1, Guilliams and Hasenstab-Lehman 2020, pp. 34-36). Additionally, *D. verityi* at EO# 1, EO# 2, and EO# 6 are all genetically distinct from each other, and we expect other untested occurrences to be similarly distinct from one another (Guilliams and Hasenstab-Lehman 2020, pp. 26-36). Further genetic studies are needed to confirm these preliminary results, and we also need additional morphometric analyses to link the genetic differences with morphological differences observed between *D. verityi* occurrences and hybrids (Guilliams and Hasenstab-Lehman 2020, p. 37).

**Current Recovery Actions:**
There are currently two projects funded by the Service to aid in recovery of *D. verityi*. Both are responses to the Springs Fire of 2013, which burned all occurrences of the species. The first of these projects (Service 2022a), led by the National Park Service (NPS), will monitor and provide supplemental water to plants at 3 of the EOs: Ridge above CSU (EO# 1), Water Treatment Plant (EO# 2), and Airfield (EO# 6). Additionally, it will provide continued maintenance for salvaged plants (plants that have been found detached from their substrate) maintained at the NPS nursery and pay for conservation seed banking by the Santa Barbara Botanic Garden of seeds from both nursery-grown and wild plants. The second project by the Santa Barbara Botanic Garden (Service 2022b) investigates lichen transplantation methods and success at the Airfield EO (# 6) and contributes to conservation seed banking efforts. If supplemental watering and lichen transplantation prove successful, they could be continued and expanded until functional lichen habitat is reestablished.

## EVALUATION OF THREATS:

At the time of listing in 1997 (Service 1997), the threats to *D. verity* were identified as rock quarrying operations, urban development, poor air quality affecting lichens, illegal collecting, and random extinction of a species of limited range and abundance because of naturally occurring, stochastic events, including fire. The 1999 recovery plan expanded fire as an additional threat to lichens (Service 1999, p. 34), and the 2009 5-year review introduced the threat of climate change to the species (Service 2009, p. 14). A following survey effort introduced the possible threats of competition from non-native plants (Dorsey et al. 2013, p. 8) and hybridization with other *Dudleya* species (Dorsey et al. 2013, p. 58). Hybridization was further emphasized by a following genetic study (Guilliams and Hasenstab-Lehman. 2020, pp. 8-9 and pp. 28-37). All these threats continue to act on the species.

**Rock Quarrying Operations:**
Effects of rock quarry operations in the range of *D. verityi* were recognized since listing (Service 1997), were mentioned in the Recovery Plan (Service 1999, p. 33), the last 5-year review (Service 2009, p. 9), and remain an active threat on the species today. EO# 2, Water Treatment Plant, which may have the largest number of plants surviving the 2013 Springs Fire, is mainly on private land on Conejo Mountain and is currently used for rock quarrying. Quarry operators proposed an expansion of their current activities at this site, and the project footprint potentially impacts EO# 2 (Benchmark Resources 2020, p. 3.5-7, Figure 3.5-3). They noted that, within the project footprint, the species was found in 2010 surveys (before the Springs Fire) but not in 2016 or 2018 surveys (after Springs Fire), and that where the species might be is “inaccessible” (Benchmark Resources 2020, p. 3.5-14). They do consider that *D. verityi* is within the expansion area, and plants would be lost with mining activities, but that loss would be mitigated with a proposed 1:1 replacement of individuals (Benchmark Resources 2020 p. 3.5-37-3.5-38). However, so far, a protocol for establishing and enhancing lichen recruitment substrate has not been established, and no details are given how plants would be propagated or transplanted. Also, given the reduced numbers of plants after the Springs Fire, 1:1 replacement is not satisfactory, especially with likely mortality after outplanting. Quarry operations, especially expansion, is a major threat to the species.

**Urban Development:**
More than half of the *D. verityi* occurrences are at least partially on public lands and are relatively protected from development (Table 1, CDFW 2023). The rest of the occurrences are on private land, where development may occur. The cliff habitat of the species may help protect it from some direct impacts of development, but modern earthmoving practices can alter what used to be impossible terrain, and steep or cliff habitat may not protect the species from the impacts of development.

Besides being federally listed as threatened, the species is a special status plant for the State of California (CNDDB 2023, p. 59) and a locally important plant for the County of Ventura (Ventura County Planning Division 2022, p. 21). However, as the 2009 five-year review discusses (Service 2009, pp. 10-11), protections are often functionally weak, and plants can still be impacted by future development. Development is uncertain and remains a current threat to *D. verityi.*

**Poor Air Quality:**
As discussed at listing (Service 1997), the recovery plan (Service 1999 p. 34), and in the last 5-year review (Service 2009, p. 12), poor air quality negatively affects lichens, which are crucial components of suitable habitat both for *D. verityi* seedling recruitment and adult survival. The 5-year review (Service 2009, pp. 12-13) describes how Ventura County air quality has improved slightly between listing in 1997 and 2009. Air quality has further improved since 2009 (California Air Resources Board 2023). However, as the 5-year review also points out, the air quality conditions that are detrimental for lichen recruitment, survival, and growth are unknown, and thus the indirect effects of air quality on *D. verityi* through lichen health can still be considered a threat to the species, although the magnitude is unknown.

**Illegal Collecting:**
Illegal collecting of the genus *Dudleya*, mostly for the foreign commercial market, has emerged as an increasing problem (e.g., Department of Justice 2021). There is one recent (late 2018) report of illegal collecting of *D. verity* at EO# 2, Water Treatment Plant, where an undetermined number of plants appear to have gone missing, and about 10 plants were dislodged and lying at the base of a cliff (K. Niessen, pers. obs.). However, poaching may be difficult to determine if not directly observed (Guilliams and Hasenstab-Lehman 2021, p. 31), and given that some of the areas where *D. verityi* occurs have high recreational traffic or are easily accessible (e.g., EO# 1 Ridge Above CSU), the likelihood of illegal collection may be high. Illegal collecting remains a threat.

**Limited Range and Number of Populations:**
The eight total known occurrences of *D. verityi* have historically been small both in occupied area and number of plants (Table 2), and have become even more reduced since the 2013 Springs Fire (Dorsey et al. 2013, p. 66). Extirpation of these small populations and local extirpation of the species by catastrophic fire, as demonstrated by the 2013 Springs Fire, and other compounding stochastic events, such as drought, remain a threat for *D. verityi*.

**Wildfire Effects:**
The direct effects of wildfire on *D. verityi* and the destruction of lichen were identified as threats to the species and its habitat in the last 5-year review (Service 2009, p. 13). While *D. verityi* typically occurs on steep, sparsely vegetated cliff faces (Dorsey et al. 2013, p. 9), these locations did not protect the species when the 2013 Springs Fire burned all known occurrences. The 2013 Springs Fire caused a severe reduction in abundance of the species, estimated at over 90% (CDFW 2023), and severely reduced the lichen substrate needed for recruitment. Fires are expected to increase in frequency and size with climate change (Hall et al. 2018, p.18), and it is not inconceivable that a fire in the near future, similar to 2013 Springs Fire, could lead to the extinction of the species. Additionally, the post-fire environment is expected to promote the abundance and cover of non-native plants, thus increasing competition between *D. verityi* and the non-natives (Dorsey et al. 2013, p. 66) while also increasing the amount of flashy fuel that can carry fire as the non-native plants increase (Hall et al. 2018, p. 53). Therefore, the negative direct and indirect effects of fire are a persistent and important threat to *D. verityi* and its habitat.

**Competition from Non-native Plants:**
Non-native plants grow adjacent to *D. verityi* plants at all surveyed occurrences (Dorsey et al. 2013, pp. 66-69, 70), and are expected to have increased in abundance and distribution after the 2013 Springs Fire. While no work on competition for space or light with non-native plants has been done for *D. verityi*, any increase in non-native plants will negatively impact the species and its habitat. Threats related to competition from non-native plants continue to act on the species.

**Hybridization:**
Suspected hybrid individuals between *D. verityi* and *D. lanceolata*, and less frequently *D. verityi* and *D. blochmaniae* subsp. *blochmaniae* have been documented at several of the occurrences (Dorsey et al. 2013, p. 65). All the plants at EO# 7 (Round Mountain) were interpreted as hybrids between *D. verityi* and *D. lanceolata* (Dorsey et al. 2013, p. 65). Guilliams and Hasenstab-Lehman (2020, entire) analyzed the genetics of plants at EO# 1 (Ridge Above CSU) and EO# 2 (Treatment Plant) and found evidence of hybridization at EO# 1. Their recommendations are that while more work needs to be done, *D. verityi* is genetically distinct at each occurrence, and the individuals from each occurrence should be kept separate in nursery and outplanting situations (Guilliams and Hasenstab-Lehman 2020, p. 37). Hybridization persists, and is an active threat to the species.

**Climate Change Effects:**
The 2009 5-year review (Service 2009, p. 14) introduced climate change as a threat to *D. verityi.* Expected climate change for the Los Angeles area include rising annual and extreme high temperatures (Hall et al. 2018, pp. 10-11), increased episodic rainfall with more extreme floods, and drier droughts (Hall et al. 2018, pp. 11-14, 18). Changes in climate will likely threaten *D. verityi* in several ways. First, as considered in the 2009 5-year review (Service 2009, p. 14), as climate changes and vegetation shifts, optimal habitat for *D. verityi* may also shift, and the species may not be able to disperse far and fast enough to match the vegetation shifts. Second, the more intensely dry summers coupled with long-term drought could kill plants. Third, more intense precipitation events could cause increased erosion on the steep cliff habitat of *D. verityi*, destroying plants and eliminating their habitat. Finally, with changing climate, non-native annual grasses and forbs are expected to increase in dominance both as a result of increased fire

frequency (Hall *et al.* 2018, p. 53) and with increasing annual temperatures (Sandel and Dangremond 2012, entire). The increased annual plant dominance can in turn both have more negative competitive effects on *D. verityi* and promote even more frequent fires. A future catastrophic fire similar to the 2013 Springs Fire could drive the species to extinction. Threats of climate change on *D. verityi* remain.

**Summary of Threats:**
Since its 1997 listing, identified threats to *D. verityi* include rock quarry operations, urban development, poor air quality, illegal collecting, random events affecting small populations, catastrophic wildfire effects, competition from non-native plants, hybridization, and climate change. Threats resulting from climate change effects may be complex, and include physical stress, death by erosion, increased competition, and increased likelihood of catastrophic fire leading to extinction. All these threats remain relevant and continue to act on the species and its habitat, and some, such as climate change effects and catastrophic wildfire, are expected to increase.

## RECOVERY CRITERIA:

We developed the following delisting criteria for *D. verityi* in the 1999 Recovery Plan (Service 1999, p. 42):

1. *All current sites (including seedbanks) are fully protected and managed with the primary intention of preserving the populations in perpetuity.*

    - This criterion has not been met. Not all sites, including those on public property, are fully protected and managed with the primary intention of preserving the populations in perpetuity.

2. *All current sites (including seed banks) are shown to be self-sustaining over a minimum of 10 years.*

    - This criterion has not been met. While there has not been adequate monitoring, current indications are that occurrences have declined overall since 2003, and have not recovered from mortality incurred in the 2013 Springs Fire.

## CONCLUSION:

We reviewed the best available scientific information and evaluated the threats affecting *D. verityi* in 2023 under factors in 4(a)(1) of the U.S. Endangered Species Act of 1973 (as amended). While more occurrences of the species (a total of 8) are known since the time of listing, all the identified threats during the time of listing continue to act on the species. These include mining, development, collecting, catastrophic wildfire, competition, and hybridization. Therefore, we conclude that the species still meets the definition of a threatened species. However, additional threats including severe wildfire have had a catastrophic impact on the species, and climate change is likely to exacerbate a number of existing threats including wildfire frequency. Because *D. verityi* is such a narrow endemic, and because all populations at all

occurrences are likely declining (especially with the 2013 Springs Fire), the species is now likely to become extinct within the foreseeable future. We recommend a change in status from threatened to endangered at this time.

**RECOMMENDATIONS FOR FUTURE ACTIONS:**

1. Continue genetic and morphometric analyses to determine the extent of hybridization with other *Dudleya* species, and deposit voucher specimens of the variation at all occurrences in herbaria.

2. Conduct thorough surveys within all known occurrences and areas of suitable habitat.

3. Conduct surveys to determine if there are additional plants in areas between the currently mapped occurrences, and if occurrences can be merged.

4. Develop and implement a monitoring plan for all occurrences. Monitoring should include population abundance surveys, habitat condition assessment, and documentation of existing and potential threats.

5. Work with public and private entities to gain access to occurrences, prevent damage to plants, and raise public awareness to support appropriate conservation measures.

6. Update and expand knowledge of the species' life history and specific habitat requirements, especially the relationship to lichens that are important for recruitment. Continue the work to enhance lichen abundance that is currently being performed so that successful outplanting to the field can occur, which would help increase overall population abundance and resiliency against severe wildfires.

7. Continue the recovery actions of supplemental watering and lichen transplantation until the pre-Springs Fire lichen habitat is reestablished.

8. Increase the number of *D. verityi* accessions in conservation seed banks, so that all known occurrences are represented in the collections.

**APPROVAL:**

**Lead Field Supervisor, Fish and Wildlife Service**

Approved STEPHEN HENRY Digitally signed by STEPHEN HENRY Date: 2023.08.24 12:56:27 -07'00'

**Regional Director, Fish and Wildlife Service**

Approved PAUL SOUZA Digitally signed by PAUL SOUZA Date: 2023.08.25 12:26:44 -07'00'

**LITERATURE CITED:**


Benchmark Resources. 2020. Pacific Rock Quarry Expansion Project. Draft Environmental Impact Report. State Clearinghouse No. 2017081052. Volume I- Executive Summary and Main Document. Benchmark Resources, Folsom, California. 398 pp.

[CARB] California Air Resources Board. 2023. Pollution trends summary for Ventura County. Retrieved 6 April 2023, from https://www.arb.ca.gov/adam/trends/trends1.php

California Plant Rescue. 2023. Online seed collection database. Retrieved 2 February 2023, from https://www.caplantrescue.org/collections-database.html#memberssearch

[CDFW] California Department of Fish and Wildlife. 2023. California Natural Diversity Database (CNDDB), RareFind 5.2.14 online database. Retrieved 2 February 2023, from https://apps.wildlife.ca.gov/rarefind/view/RareFind.aspx

[CNDDB] California Department of Fish and Wildlife, Biogeographic Data Branch, California Natural Diversity Database (CNDDB). 2018. How to Read CNDDB Quad Overlays. California Natural Diversity Database, Sacramento, California. 3 pp.

[CNDDB] California Natural Diversity Database. January 2023. Special Vascular Plants, Bryophytes, and Lichens List. California Department of Fish and Wildlife. Sacramento, CA. 155 pp.

Department of Justice. 2021. South Korean National Pleads Guilty to Federal Criminal Charge for Poaching Wild Succulent Plants for Illegal Exportation to Asia. Press Release 21-185 updated 9 September 2021. Retrieved 12 January 2023, from https://www.justice.gov/usao-cdca/pr/south-korean-national-pleads-guilty-federal-criminal-charge-poaching-wild-succulent

Dorsey A., T. Sagar, L. Aguilar, and J. Tiszler. 2013. Census of Federally Listed Threatened Dudleya Taxa in the Santa Monica Mountains and Vicinity. Report to USFWS, Ventura Office. 95 pp.

Guilliams, C.M. and K.E. Hasenstab-Lehman. 2021 Post-Fire Surveys and Threat Assessment for Rare *Dudleya* Taxa within the 2018 Woolsey Fire Burn Scar. Draft final report to California Department of Fish and Wildlife. Santa Barbara Botanic Garden, Santa Barbara, California. 113 pp.

Guilliams, C.M. and K.E. Hasenstab-Lehman. 2020. High-throughput sequencing reveals a complicated evolutionary history between endangered *Dudleya verityi*, (Crassulaceae) and a widespread congener, *D. lanceolata*. Award Number F15AP00680. Santa Barbara Botanic Garden, Santa Barbara, California. 45 pp.

Hall, A., N. Berg, and K. Reich. 2018. Los Angeles Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-007.

Riefner, R.E. Jr., P.A. Bowler, T.W. Mulroy, and C. Wishner. 2003. Lichens of rock and biological crusts enhance recruitment success of rare *Dudleya* species (Crassulaceae) in Southern California. Crossosoma 29: 1-36.

Sandel, B., and E.M. Dangremond. 2012. Climate change and the invasion of California by grasses. Global Change Biology 18: 277-289.

[Service] U.S. Fish and Wildlife Service. 1997. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for Two Plants and Threatened Status for Four Plants from Southern California. FR 62 4172--4183.

[Service] U.S. Fish and Wildlife Service. 1999. Recovery Plan for Six Plants from the Mountains Surrounding the Los Angeles Basin. Portland, Oregon. 67 pp.

[Service] U.S. Fish and Wildlife Service. 2009. *Dudleya verityi* (Verity's Dudleya) 5-Year Review: Summary and Evaluation. Ventura Fish and Wildlife Office. Ventura, California. 20 pp.

[Service] U.S. Fish and Wildlife Service. 2022a. Emergency Recovery Actions for Verity's Dudleya (*Dudleya verityi*) after Severe Fire and with Ongoing Drought: Scope of Work. 2 pp.

[Service] U.S. Fish and Wildlife Service. 2022b. Recovery of *Dudleya verityi* K. Nakai After Severe Fire by Reestablishment of Lichen Communities: Revised Scope of Work. 4 pp.

Ventura County Planning Division. 2022. 2022 Locally Important Plant List. 36 pp.