

## 5-YEAR REVIEW

### *Dudleya stolonifera* (Laguna Beach liveforever)

#### GENERAL INFORMATION

**Species:** *Dudleya stolonifera* (Laguna Beach liveforever), a plant species

**Date listed under the Endangered Species Act:** October 13, 1998

**Federal Register citation:** USFWS 1998 (63 FR 54938–54956)

**Classification:** Threatened

#### BACKGROUND

Under the Endangered Species Act of 1973, as amended (Act; 16 U.S.C. 1531 *et seq.*), the U.S. Fish and Wildlife Service (USFWS), referred to as “we” in this document, maintain lists of endangered and threatened wildlife and plant species (referred to as the List) in the Code of Federal Regulations (CFR) at 50 CFR 17.11 (for wildlife) and 17.12 (for plants). Section 4(c)(2)(A) of the Act requires us to review each listed species' status at least once every 5 years.

**Most recent status review:** USFWS. 2010. *Dudleya stolonifera* (Laguna Beach liveforever); 5-year Review: Summary and Evaluation. Carlsbad Fish and Wildlife Office, Department of the Interior. 23 pp.

We initiated a status review for *Dudleya stolonifera* in 2009. The review was finalized on April 16, 2010 and recommended no change in status.

**Federal Register notice citation announcing this status review:** On January 27, 2020, we published a *Federal Register* notice announcing initiation of the 5-year review of this species, and the opening of a 60-day period to receive information from the public (USFWS 2020). No comments relative to the *Dudleya stolonifera* were received.

#### ASSESSMENT

##### Information acquired since the last status review

This 5-year review was conducted by the USFWS Carlsbad Field Office. Data for this review were solicited from the public and interested parties through a *Federal Register* notice announcing this review on January 27, 2020. We used information in the 1998 listing rule, 2010 5-year review, available literature, reports, and information in our files. We also contacted California Department of Fish and Wildlife, the Orange County Chapter of the California Native Plant Society, the Natural Communities Coalition, City of Laguna Beach, and species experts to request any data or information we should consider in our review.

## SUMMARY OF NEW INFORMATION SINCE 2010

### Biology and Distribution

*Dudleya stolonifera* is a narrow endemic known from north facing rocky outcrops on sandstone and the San Onofre Breccia formation in the vicinity of Laguna Beach, California. All six historical occurrences are presumed extant, although systematic surveys of all occurrence have not been conducted and abundance of plants at several locations may be in decline (Figure 1; Vanderhoff 2020a, pers. comm.). Table 1 and 2 summarizes the most recent data since the last 5-year review including an estimate of the number of rosettes at each location, and current threats, when that information was available. Rosettes represent the actively growing, visible portion of the plant; but do not represent distinct individuals, as one to many rosettes can be attributed to a single individual. Individuals cannot be readily distinguished in the field due to their growth form and access constraints. It is likely that previous records of individuals also recorded rosettes, although that information is often not explicit. A summary of each location is presented below by geographic area and follows the order of Table 1 and 2.

#### *Aliso Creek Watershed*

Aliso Canyon [California Natural Diversity Database (CNDDDB) Element Occurrence (EO) 2] was visited in 2021 and the occurrence is considered stable. The species was documented at the type locality (location where the original type specimen was located) at the mouth of Aliso Canyon and was recently observed more or less contiguously for 0.7 miles east of that location (Simonsen 2021, pers. obs.). This extends the distribution of this occurrence by approximately 0.4 miles. In total, approximately 5,000 to 10,000 rosettes were observed, compared to 1,000 recorded in 1991, due to the increase in the area occupied and number detected. These individuals were likely previously extant although undiscovered at that time due to lack of surveys and restricted access on private land. A relatively low number of seedlings (less than 5 years old) were observed and no 1-year old seedlings were recorded indicating that recruitment was reduced potentially due to drought, although this survey was not comprehensive. Individuals reach reproductive maturity at approximately 5 years of age. Four to five outcrops were accessed for direct counts; the rest of the occurrence was periodically assessed by binoculars and smaller individuals may have been missed.

Mathias Canyon (EO 7) was last visited in 2019 and the occurrence is in decline. Approximately 5,000 to 10,000 rosettes were observed, compared to 20,000 in 1992. The decline in the abundance of plants is attributed to extended drought conditions between 2015 and 2018 (Vanderhoff 2021, pers. comm.).

#### *Laguna Canyon Watershed*

Canyon Acres (EO 5) was last visited in 2012 and the occurrence was considered stable, with less than 100 individuals observed. The occurrence is presumed extant, although a recent attempt in 2021 did not relocate the species (Vanderhoff 2021, pers. comm.).

Lateral Canyon B (EO 6) was last visited in 2014 and plants were observed, although there is no new information on abundance or threats available (Calflora 2021, unpaginated).

Big Bend (EO 1) was last visited in 2021 and estimated at approximately 1,000 to 5,000 rosettes (Vanderhoff 2021, pers. comm.). The number of plants decreased since observations in 1983 when greater than 10,000 plants were observed (CNDDDB 2021, unpaginated).

Laguna Laurel Canyon (EO 4) was visited in 2020 and is considered stable. Approximately 500 to 1,000 rosettes were observed (Vanderhoff 2021, pers. comm.). Up to 10,000 plants were recorded in the early 1980's but records indicate 50 to 1,000 individuals over the last several decades (CNDDDB 2021, unpaginated).

Based on these updates, there are six occurrences of *Dudleya stolonifera*. Three are extant with stable or increasing population estimates. One occurrence is extant, but appears to be declining in number (Mathias Canyon). The remaining two occurrences have not been assessed for greater than 7 years; however the habitat is intact and both occurrences are presumed extant.

Dorsey and Wilson (2011) evaluated life history characteristics in nine species of *Dudleya* that occur in the Santa Monica Mountains. Based on patterns in the differences in the size and reproductive vigor of the rare and more common taxa, they hypothesize the rare *Dudleya* species have followed an evolutionary strategy of allocating more resources to early reproduction at the expense of allocating resources to growth. Conversely, the more common species were larger (i.e., devoted more resources to growth) and had delayed sexual maturity. This trade-off may confer a competitive advantage to the rare taxa on the steep and/or rocky outcroppings where the rare taxa typically occur or represent specific environmental adaptations to geology and climate. However, the smaller rare taxa were observed to have an overall smaller reproductive output and decreased vigor in warmer, inland environments. Both life history characteristics (early reproduction, low reproductive output) may ultimately constrain the ability of narrow-endemic species, like *Dudleya stolonifera*, to expand their range and population size, and respond to disturbance and climate change. Overall, the study highlights how narrow-endemic *Dudleya* species are more threatened in part due to their high degree of specialization, which ultimately may limit their adaptability. They also discuss that lichen distribution may limit the range of rare species, which may constrain the ability of the species to adapt to a changing climate.

## **Taxonomy**

Yost (2013) evaluated the phylogenetic relationships within the genus *Dudleya* and found support for a monophyletic group at the genus level, based on a study of the diploid species. Polyploidy occurs within approximately 35 members of the genus; and polyploidy and hybridization are known to complicate the deciphering of evolutionary relationships. Previous subgeneric classifications were based on petal orientation and stem morphology resulting in the subgenera *Dudleya*, *Hasseanthus* and *Stylophyllum* (Yost *et al.* 2013, p. 1096). Their results indicate that these morphological traits are not good indicators of relatedness. They identified four clades (Virens, Blochmaniae, Ingens, and Formosa) distinguished in part by leaf morphology and geographic region. Associations with specific soils appears to have evolved numerous times (Yost 2013, entire). *Dudleya stolonifera* diverged from the common ancestor for all *Dudleya* species and is not associated with a subgenus.



**Table 1. Summary of the Status of *Dudleya stolonifera* Occurrences in Aliso Creek Watershed.**

Occurrence (Location)	Element Occurrence	Current Status	Number of Rosettes (Year Surveyed; Reference)	Current Threats	Ownership	Conservation Mechanism	Year Documented and Observer (Herbarium Record)
Aliso Canyon (The Ranch at Laguna Beach, previously known as the Aliso Creek Inn and Golf Course)	EO 2	Presumed extant	1,000 (1991; CNDDDB 2010)  5,000-10,000 (2021; Simonsen 2021, pers. obs.)	<b>Factor A:</b> Development and nonnative plants. <b>Factor E:</b> Nonnative plants and climate change.	Private, eastern limit extends onto County Parks (CNDDDB 2010a; USFWS GIS 2021)	Approximately 1 percent occurs within Aliso and Woods Canyon Wilderness Preserve (USFWS GIS 2021).	1949 Moran 3287 (UC905131, RSA 397833) 1925 Moran 3259 (UC 933268) 1925 Reed 4994 (POM48549) 1948 Moran 3095 (UC806717, UC905132, POM 301406, DS342181) 1912 Moran 24238 (SD 130042) 1967 Perkins (RSA423513) 2006 Howe 4363 (SD114480) 2006 Athens/PCR Services (CalFlora cel147; Hole 3) 2021 Simonsen and Vanderhoff <sup>3</sup>
Mathis Canyon (Upper Aliso Creek/Temple Hill East/ Bonn Drive)	EO 7	Presumed extant	20,000 (1991; CNDDDB 2021)  5,000-10,000 (2019; Vanderhoff 2021, pers. comm.)	<b>Factor A:</b> Development (fuel modification) <b>Factor E:</b> Climate change	City of Laguna Beach - parcel #82 (USFWS GIS 2021).	Managed by Orange County in Aliso and Wood Canyons Wilderness Park	Unvouchered 2019 Vanderhoff

**Table 2. Summary of the Status of *Dudleya stolonifera* Occurrences in Laguna Canyon Watershed.**

Occurrence (Occurrence Alias)	Element Occurrence	Current Status	Number of Rosettes (Year Surveyed; Reference)	Current Threats	Ownership	Conservation Mechanism	Year Documented and Source (Herbarium Record/ Observer)
Canyon Acres (Lower Laguna Canyon)	EO 5	Presumed extant	<60 (1982; CNDDDB 2021)  <100 (2012; Vanderhoff 2021, pers. comm.)	<b>Factor A:</b> Development (fuel modification). <b>Factor E:</b> Small population size and climate change.	Private (CNDDDB 2021). Directly adjacent lots to east are owned by City of Laguna Beach (parcels #140, #145)	Unknown	Unvouchered 2012 Vanderhoff
Lateral Canyon B (Lower Laguna Canyon)	EO 6	Presumed extant	Small (1972; CNDDDB 2010)	<b>Factor E:</b> Small population size and climate change.	Orange County	Managed by Orange County in Laguna Coast Wilderness Park	Unvouchered 2014 CalFlora (ce923)
Big Bend (Lower Laguna Canyon)	EO 1	Presumed extant	10,000 (1983; CNDDDB 2021)  1,000 -5,000 (Vanderhoff 2021, pers. comm.)	<b>Factor A:</b> Development <b>Factor E:</b> Development (fuel modification), trampling, and climate change.	City of Laguna Beach (parcel #157)	Unknown	1949 Moran 3286 (UC905134); Moran 3411(UC 1015150) 1984 Roberts 1360 (IRVC25030) 2011 McCabe (CCH 4065799) 2021 Vanderhoff
Laguna Laurel Canyon (Upper Laguna Canyon/Willow Canyon/Irvine Ranch)	EO 4	Presumed extant	2,561 (1991; CNDDDB 2021)  500 - 1,000 (2020, Vanderhoff 2021, pers. comm.)	<b>Factor A:</b> Nonnative plants <b>Factor B:</b> Horticultural collection. <b>Factor E:</b> Nonnative plants, trampling, hybridization, and climate change.	Orange County	Managed by Orange County Parks	1977 Moran 24230 (RSA534167, SD129960, UCR 67711, SBBG96432) 1985 Roberts 1815 (IRVC22787) 2003 Muns/Chester (ce197 CalFlora)

## **Threats**

The 1998 listing rule identified potential threats to *Dudleya stolonifera* from: 1) trampling and grazing; 2) competition with nonnative plants; 3) the effects of urbanization (e.g., habitat fragmentation, increased shading, and fuel modification); 4) horticultural collection; and 5) factors related to a small population size (USFWS 1998, p. 54945, 54950). In the 2010 5-year review climate change was identified as a new threat. This section summarizes new information about threats. Updates to threats in this status review are discussed under the following headings: trampling, nonnative plants, urbanization, horticultural collection, small population size, and climate change. In addition, hybridization was identified as a new threat.

### ***Trampling***

In 2010, trampling and grazing of *Dudleya stolonifera* was not considered a specific threat to any of the six occurrences. Trampling and grazing is currently of limited concern due to the inaccessibility of most occurrences and the steep terrain where the species occurs. However, trampling is an on-going threat at the Big Bend and Laguna Laurel Canyon occurrences because the species is readily visible and accessible from trails at these locations. Trampling could occur during recreational activities including rock climbing and bouldering at Laguna Laurel Canyon, and potential by mountain bikes at Big Bend, although no direct impacts to the species were recorded (Vanderhoff 2020, pers. comm.).

### ***Nonnative Plants***

Nonnative plant competition was a threat at Aliso Canyon and Mathis Canyon in 2010 and is currently a concern at the Aliso Canyon and Laguna Laurel Canyon occurrences. The greatest threat is the competition with *Aeonium haworthii* (Haworth's aeonium) in Aliso Canyon, although *Tropaeolum majus* (nasturtium), *Brassica* spp. (mustard), *Echium candicans* (pride of Madeira), and nonnative grasses were also observed (Simonsen 2021, pers. obs.; Vanderhoff 2020a, pers. comm.). Potential impacts include competition for space, resources, and pollinators. The distribution of *A. haworthii* is expanding and extends up the canyon where it occupies the same habitat of *D. stolonifera* but is substantially larger, growing up to 2 feet in height.

### ***Development***

In 2010, development was considered a threat at four occurrences. No development permits were issued in the last 10 years with the potential to impact *Dudleya stolonifera* (USFWS 2021; Osborne 2020, pers. comm.; Snyder 2020, pers. comm.). However, development is an on-going threat for occurrences on private property or in municipalities that do not participate in the Orange County Central-Coastal Natural Community Conservation Plan (NCCP)/Habitat Conservation Plan. In addition, the indirect effects of urbanization such as fire fuel modification remain a threat to the Aliso Canyon, Canyon Acres, and Big Bend occurrences.

### ***Horticultural Collection***

In the previous 5-year review, horticultural collection was not identified as a specific threat to *Dudleya stolonifera* because the species was available in area nurseries and the most accessible occurrence locations were already extirpated (USFWS 2010, p. 9). In 2010, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) reduced the international trade protections for *Dudleya stolonifera*. The species was previously listed on

Appendix I, which includes species threatened with extinction where trade is permitted only in exceptional circumstances. In 2010 the 15th meeting of the Conference of the Parties adopted Appendix II for *D. stolonifera*, by which trade “must be controlled in order to avoid utilization incompatible with their survival” (CITES 2020). The Service supported this proposal, and recommended removal from Appendix II, as there was no evidence of collection or trade of plants collected from the wild at that time (USFWS 2012).

Currently botanists that regularly observe the extant populations have not observed any sign of horticultural collection (Vanderhoff 2020a, pers. comm.); but collection remains an on-going concern, particularly at accessible sites such as Aliso Canyon and Laguna Laurel Canyon. State and Federal wildlife agents have identified a recent surge in *Dudleya* poaching along the California coastline (CNPS 2021, unpaginated). This surge in poaching, to support the international sale of *Dudleya* species, has prompted the California Assembly to approve a bill (AB 223) to make *Dudleya* poaching illegal. The bill is currently awaiting action by the State Senate and Governor to be enacted. Thus, although no direct observations of poaching of *D. stolonifera* has been documented; the threat of collection may be elevated by an increased international demand for specimens within the genus.

### ***Small Population Size***

In 2010, small population size was identified as a threat to two occurrences (Canyon Acres and lateral Canyon B). Small population size is an on-going threat at occurrence with less than 100 rosettes. These occurrences are more vulnerable to stochastic events and may suffer from inbreeding depression, although no observable genetic or physical effects have been observed.

### ***Climate Change***

Climate change was identified as a new threat in our 2010 5-year review due to the likelihood that increasing temperatures and summer drying may impact plant species and the associated vegetation where they occur (USFWS 2010, p. 16). *Dudleya stolonifera* is a narrow endemic adapted to steep, north-facing, rocky outcrops of particular geology along the coast. The high degree of specialization may ultimately constrain the species adaptability (Dorsey and Wilson 2011, p. 1111). There is also limited suitable habitat to accommodate a potential range shift within the species range in the coastal, southern Orange County.

The extended drought conditions from 2015 to 2018 resulted in reduced growth, reproduction, and recruitment across all occurrences (Vanderhoff 2020, pers. comm). A decline in new seedlings was recorded and, in some cases, reduced moss, fern, and lichen cover. The species was also observed to senesce earlier in the season under drought conditions. Similarly, associated lichens including *Niebla ceruchoides* (angel-hair sea fog lichen) that may facilitate establishment by capturing seeds were dormant for much of this period (Riefner and Bowler 1995, p. 81; USFWS 2010, p. 7; Vanderhoff 2020, pers. comm.).

### ***Hybridization***

Species within the genus *Dudleya* are known to hybridize with other co-occurring *Dudleya* species. In particular, *D. stolonifera* is documented to hybridize with *D. edulis* (ladyfingers) and was identified as a threat by California Department of Fish and Wildlife (CNDDDB 2021, unpaginated).

The potential for hybridization is on-going in occurrences where both species occur such as Aliso Canyon. However, hybridization has not been confirmed.

## CONCLUSION

Since the 2010 5-year review, we received new information about ongoing threats at *Dudleya stolonifera* occurrences. The new information related to the threats of trampling, horticultural collection, drought, and hybridization. However, the new information does not alter the conclusion of our 2010 5-year review (USFWS 2010, pp. 8–17).

Therefore, after reviewing the best available scientific information, we conclude that Laguna Beach liveforever remains a threatened species. The threats identified at listing and discussed in the 2010 5-year review are on-going and hybridization has been identified as a new threat. Aside from hybridization, the evaluation of threats affecting the species under the factors in 4(a)(1) of the Act and analysis of the status of the species in our 2010 5-year review remains an accurate reflection of the species current status.

## RECOMMENDATIONS FOR FUTURE ACTIONS

The recommended actions listed below are to be completed over the next 5 years. Successful implementation of these actions will reduce threats to *Dudleya stolonifera* and provide information to better understand the biological and physical factors limiting the population growth and distribution. We recognize that conservation of this taxon will require cooperation and coordination with partners to minimize impacts from current threats and aid with future restoration efforts.

1. Create and implement a protocol for range wide surveys and monitoring to track the status and trend of the species. Collect voucher specimens at all unvouchered populations.
2. Preserve and restore occupied habitat on private lands (Aliso Canyon-EO 2, and Canyon Acres-EO 5).
3. Develop a strategy to manage nonnative plants, particularly *Aeonium haworthii* should the species continue to spread in Aliso Canyon (Aliso Canyon-EO 2 and Laguna Laurel Canyon-EO 4).
4. Educate homeowners regarding the threat of invasive plants, particularly *Aeonium haworthii*, at the Aliso Canyon occurrence.
5. Research *Dudleya stolonifera* reproductive strategies and pollinator requirements to determine if reduced pollination is contributing to declines in recruitment.
6. Conduct a genetic study to determine if there is gene flow between populations and assess genetic variability to determine if threats associated with small population size are realized. A genetic study could also help evaluate the degree of hybridization.

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### **Personal Communication**

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Vanderhoff, R. 2020a. Botanist and Vice President of the Orange County Chapter of the California Native Plant Society. Phone call correspondence to Julie Simonsen, Fish and Wildlife Biologist, USFWS, Carlsbad Fish and Wildlife Office, Carlsbad, California. Dated May 28, 2020. Subject: Status of *Dudleya stolonifera* occurrences and approach for future monitoring.

Vanderhoff, R. 2020b. Botanist and Vice President of the Orange County Chapter of the California Native Plant Society. Email correspondence to Julie Simonsen, Fish and Wildlife Biologist, USFWS, Carlsbad Fish and Wildlife Office, Carlsbad, California. Dated April 21, 2020. Subject: Photos of *Dudleya stolonifera* taken during surveys and associated field notes.

**FIELD OFFICE APPROVAL**

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

Approve

Scott A. Sobiech  
Field Supervisor