Santa Monica Mountains Dudleya
(*Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis*)

5-Year Review:
Evaluation and Summary

Dudleya cymosa subsp. *agourensis* Photo: Tarja Sagar

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

August 2021

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GENERAL INFORMATION:
Species: *Dudleya cymosa* subsp. *ovatifolia* (including subsp. *agourensis*)
FR citation: 62 FR 4172
Date listed: July 29, 1997
Classification: Threatened

BACKGROUND:

Most recent status review:
U.S. Fish and Wildlife Service. 2009. *Dudleya cymosa* subsp. *ovatifolia* (Santa Monica Mountains dudleya) 5-Year Review: Summary and Evaluation. Ventura Field Office. Ventura, California.

FR Notice citation announcing this status review:
Initiation of 5-Year Status Reviews of 66 species in California and Nevada. Notice of initiation of reviews; request for information (85 FR 4692), January 27, 2020.

ASSESSMENT:
Dudleya cymosa subsp. *ovatifolia* (Crassulaceae) is a succulent perennial herb. While the name as listed in 1997 is *Dudleya cymosa* subsp. *ovatifolia*, the taxon was recognized as being a combination of *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis*, which are now fully accepted as two taxa (McCabe 2012, p. 670). Additionally, there is evidence that Orange County plants formerly considered to be *Dudleya cymosa* subsp. *ovatifolia* are either one or more undescribed taxa (Hasenstab-Lehman and Guilliams 2020, p. 27, K. Hasenstad-Lehman pers. comm. 2021), or as described in the 2009 5-year review, *Dudleya cymosa* subsp. *pumila*. In this 5-year review, we evaluate the status of all populations that were identified as *Dudleya cymosa* subsp. *ovatifolia* at the time of listing; if not otherwise indicated, reference to this taxon includes *Dudleya cymosa* subsp. *agourensis*. For certain discussions, we have also noted which of these populations are now considered to be *Dudleya cymosa* subsp. *agourensis* or an undescribed taxon.

Dudleya cymosa subsp. *ovatifolia*, in the broad sense, occurs in Ventura, Los Angeles, and Orange Counties. The Ventura and Los Angeles County plants occur on land owned by California Department of Parks and Recreation (CDPR), Mountains Recreation and Conservation Authority (MRCA), Santa Monica Mountains Conservancy (SMMC), Conejo Open Space Conservation Authority (COSCA), Las Virgenes Municipal Water District (LVMWD), and private landowners, while the Orange County plants occur on lands owned by the U.S. Forest Service, Orange County Parks, and private landowners. All occurrences of *Dudleya cymosa* subsp. *ovatifolia*, in the strict sense, occur within 15 miles of each other in south-trending canyons of the western Santa Monica Mountains in Los Angeles County. All occurrences of *Dudleya cymosa* subsp. *agourensis* occur in a 2-mile by 6-mile band along the

north-facing side of the western Santa Monica Mountains between Thousand Oaks in Ventura County and Agoura Hills in Los Angeles County. The potentially undescribed taxa occur in Modjeska and Santiago Canyons of the Santa Ana Mountains in Orange County. Additionally, plants on the slope of Modjeska Peak were formerly considered *Dudleya cymosa* subsp. *ovatifolia*, but were subsequently identified as *Dudleya cymosa* subsp. *pumila*. The taxonomy of the plants in the Santa Ana Mountains is currently unclear and needs additional study (see below).

Information acquired since the last status review:
This 5-year review was conducted by the U.S. Fish and Wildlife Service (Service) Ventura Fish and Wildlife Office with input from the Carlsbad Fish and Wildlife Office. Data for this review were solicited from interested parties through a Federal Register notice announcing this review on January 27, 2020. We did not receive any responses to this solicitation. 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.

Taxonomy:
The listing of *Dudleya cymosa* subsp. *ovatifolia* (Santa Monica Mountains dudleya) in 1997 included plants now identified as *Dudleya cymosa* subsp. *agourensis* (Agoura Hills liveforever). Both subspecies are currently recognized as distinct taxa (USFWS 2009 pp. 2, 7–8; McCabe 2012 p. 670); however, this distinction is not yet reflected in the list of endangered and threatened plants (50 CFR 17.12).

At listing in 1997, we identified two *Dudleya cymosa* subsp. *ovatifolia* occurrences in the Santa Ana Mountains of Orange County, one in Modjeska Canyon, and the other in Santiago Canyon. In the 2009 5-year review, it was reported that the Modjeska and Santiago Canyon plants are part of a single population, and that two additional occurrences on Modjeska Peak are *Dudleya cymosa* subsp. *pumila* (USFWS 2009, p. 6). Therefore, in the 2009 5-yr review, we considered *Dudleya cymosa* subsp. *ovatifolia* to occur in Orange County only in a single population of two CNDDB Element Occurrences in Modjeska and Santiago Canyons (USFWS 2009 p. 6).

Recent genetic work by Hasenstab-Lehman and Guilliams (2020) found that the plants they sampled from Santiago Canyon did not group with *Dudleya cymosa* subsp. *ovatifolia* plants in the Santa Monica Mountains, supporting that plants that have been called subspecies *ovatifolia* in the Santa Ana Mountains are at least one undescribed taxon (Underwood 2021 pp. 40–41, Hasenstab-Lehman and Guilliams 2020 pp. 23, 27, K. Hasenstad-Lehman pers. comm. 2021). Hasenstab-Lehman and Guilliams (2020 Table 3) only analyzed samples from Santiago Canyon, and more study is needed to confirm the identities of the plants in adjacent Modjeska Canyon and more distant Modjeska Peak. There is a possibility that the Modjeska Canyon plants represent a second undescribed taxon in the Santa Ana Mountains (K. Hasenstad-Lehman pers. comm. 2021).

Population data—distribution:
The California Natural Diversity Database (CNDDB) of the California Department of Fish and Wildlife defines an Element Occurrence (EO) as a group of a species separated from another group of that species by one quarter mile (CNDDB 2018). Table 1 lists the EOs of *Dudleya*

cymosa subsp. *ovatifolia, Dudleya cymosa* subsp. *agourensis*, the undescribed Orange county taxa, and Modjeska Peak *Dudleya cymosa* subsp. *pumila.*

Table 1. *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis* Element Occurrences (EO) in the California Natural Diversity Database (CNDDB). At the time of the 1999 Recovery Plan all were considered to be *Dudleya cymosa* subsp. *ovatifolia*, (DCO) but subsequently EO identities were reinterpreted, EO numbers were reassigned or reused, and EOs were combined, making the history of some EOs, especially 3, unclear.

Data from CNDDB 2021, Service 1999, and Service 2009. USFS-CNF = US Forest Service-Cleveland National Forest, CDPR = California Department of Parks and Recreation, COSCA = Conejo Open Space Conservation Agency, MRCA = Mountains Recreation and Conservation Authority, LVMWD = Las Virgenes Municipal Water District, SMMC = Santa Monica Mountains Conservancy

1999 EO	2009 EO	2021 EO	Current taxonomic status	County	Location	Owner	Notes
1	1 (DCO)	none	unclear	Orange	Modjeska Cyn,	USFS-CNF, private, unknown	Includes 2009 EO11. Excluded by CNDDB 2021.
none	11 (DCO)	none	undescribed	Orange	Santiago Cyn	USFS-CNF	Included in EO1 in 2009 5-yr review. Excluded from CNDDB 2021.
2	2	2	subsp. *ovatifolia*	Los Angeles	Topanga Cyn	CDPR	
8	8	8	subsp. *ovatifolia.*	Ventura	Arroyo Sequit	unknown	Identification uncertain; not considered by some to be subsp. *ovatifolia* (Service 2009), but retained by CNDDB.
none	10	10	subsp. *ovatifolia*	Los Angeles	Malibu Creek	CDPR	
9	9, 12	none	subsp. *pumila*	Orange	Modjeska Peak slopes	USFS-CNF	Excluded by CNDDB 2021.
6	1	1	subsp. *agourensis*	Ventura	Potrero (Lake Sherwood)	COSCA	Was 1997 DCO EO6.
7	2,3	2	subsp. *agourensis*	Ventura	West of Lake Eleanor	COSCA	Was 1997 DCO EO7.
3	3	3	subsp. *agourensis*	Los Angeles/ Ventura	East of Lake Elanor	unknown	
3	4,5	4	subsp. *agourensis*	Los Angeles	Upper Triunfo Cyn	MRCA, LVMWD, private	2021 includes 1997 DCO EO3 and 2009 EO5.
4	6	6	subsp. *agourensis*	Los Angeles	Ladyface	private	Was 1997 DCO EO4.
5	7	7	subsp. *agourensis*	Ventura	Cornell/Kanan Rds (Agoura Hills)	private	Was 1997 DCO EO5.
none	none	9	subsp. *agourensis*	Los Angeles	Triunfo Cyn	MRCA- Triunfo Cyn Park	
none	none	10	subsp. *agourensis*	Los Angeles	Ladyface Court	SMMC, City of Agoura Hills	

Table 1 attempts to crosswalk EO numbers used previously in the 1999 Recovery Plan and the 2009 5-year review. There is some uncertainty about several of the EOs because between 1999 and 2009 CNDDB recognized the distinction between subspecies *ovatifolia* and *agourensis*, and between 2009 and 2021 CNDDB removed the undescribed taxa and the misidentified *Dudleya cymosa* subsp. *pumila* from their database, and some existing EOs were combined based on distance. This resulted in 1999 EO numbers being reassigned or reused. In particular, the EO number "3" seems to have been applied in an overlapping way over 1999, 2009, and 2021. Most of the 2021 EOs are well defined, and should be a good standard for *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis* into the future.

Future clarification is needed about the identity of EO8. In the 2009 5-year review, EO8 was not considered to be *Dudleya cymosa* subsp. *ovatifolia* or *Dudleya cymosa* subsp. *agourensis.* However, CNDDB has been consistent in listing it to be *Dudleya cymosa* subsp. *ovatifolia*. EO8 was addressed but not completely resolved in 2010 surveys (Dorsey *et al.* 2013, p. 13), when no plants were found and habitat at the site appeared unsuitable.

Population data—abundance:
There has been little structured repeat surveying over the years of any of the taxa, making determination of abundance trends difficult. However, recently Guilliams and Hasenstab-Lehman (2021 pp. 35-37), working under a 2019 Section 6 grant, developed repeatable survey methods, providing a baseline for future surveys to better assess changes in population abundance of *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis*. Table 2 presents abundance data for *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis* in the Santa Monica Mountains. Guilliams and Hasenstab-Lehman developed a metric to describe population stability, included as "2020 EO stability" in Table 2. The 2020 EO stability metric is a comparison of the number of plants counted in 2020 as compared to previous counts in any year. A "stable" EO is one where the 2020 count is greater than a count in any other year, and "mixed" stability is where at the 2020 count was between numbers of previous years. For *Dudleya cymosa* subsp. *ovatifolia*, EO2 scored as being stable and EO10 was mixed; EO8 was not assessed. For *Dudleya cymosa* subsp. *agourensis*, all EOs scored as stable, except EO9 which was scored as "stable?", with the 2020 count (90 plants) lower than the 2010 count (202 plants).

There is no available information about the current abundance of any of the populations in the Santa Ana Mountains.

Table 2. Changes in abundance of *Dudleya cymosa* subsp. *ovatifolia* and subsp. *agourensis* E over time.
CNDDB = California Natural Diversity Database, EO = Element Occurrence. Data from CNDDB 2021, Guilliams and Hasenstab-Lehman 2021, and Dorsey *et al.* 2011.

CNDDB EO #	Subspecies	Dates and Numbers	2020 EO stability
2	*ovatifolia*	**1948** present, **1967** present, **1980** present, **1984** present, **2010** 91, **2020** 156	stable
8	*ovatifolia*	**1960** present, **1980** present, **2010** none present (as *agourensis* in Dorsey *et al.* 2013)	unknown

CNDDB EO #	Subspecies	Dates and Numbers	2020 EO stability
10	*ovatifolia*	**1960** present, **1980** present, **2006** several thousand, **2010** 800, **2011** 50+, **2020** 1778	mixed
1	*agourensis*	**1990** 100, **2010** 810, **2020** 953	stable
2	*agourensis*	**1986** 100, **2010** 0, **2020** 801	stable
3	*agourensis*	**1980** present, **2010** 0, **2020** 2183	stable
4	*agourensis*	**1986** present, **1990** present, **1992** ~1000, **1998** present, **2010** 9699+, **2020** 12732	stable
6	*agourensis*	**1990** 100, **2020** 1040	stable
7	*agourensis*	**2000** 250, **2010** 4764+, **2011** 25+, **2014** 142, **2015** 453, **2020** 3876	stable
9	*agourensis*	**2010** 202, **2020** 90	stable?
10	*agourensis*	**2016** hundreds, **2020** 2655	stable

Seed banking:
There are accessions of *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis* seed in Center for Plant Conservation approved conservation seed banks (Table 3). However, these are relatively few over time for *Dudleya cymosa* subsp. *ovatifolia*, and relatively few among EOs and over time for *Dudleya cymosa* subsp. *agourensis*. There is no conservation seed bank for the undescribed Santa Ana Mountains taxa.

Table 3. *Dudleya cymosa* subsp. *agourensis* and subsp. *ovatifolia* conservation seed banking. The *agourensis* collection of 7/29/1998 was originally listed in the reference database (CaPR 2021) by the previous name of *ovatifolia* for that occurrence.

CNDDB = California Natural Diversity Database, EO = Element Occurrence, CBG = California Botanic Garden, SBBG = Santa Barbara Botanic Garden. Data from CaPR 2021.

CNDDB EO #	Subspecies	Collection date	Facility	By maternal line or unknown	# maternal lines	# seeds
2	*ovatifolia*	9/12/2020	SBBG	maternal line	39	6,138
10	*ovatifolia*	7/18/2006	CBG	maternal line	60	5,828
10	*ovatifolia*	9/12/2020	SBBG	maternal line	49	25,940
4	*agourensis*	7/29/1998	CBG	unknown	-	11,133
4	*agourensis*	8/28/2020	SBBG	maternal line	28	59,385
4	*agourensis*	8/28/2020	SBBG	maternal line	30	33,901
7	*agourensis*	8/6/2000	CBG	maternal line	6	5,400
10	*agourensis*	8/28/2020	SBBG	maternal line	37	21,943

EVALUATION OF THREATS:

Threats identified for *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis.* include urban development, illegal collecting, recreational activities, small population size effects, hybridization, non-native plants, fire, and climate change. These identified threats are evaluated below. The 2009 5-year review considered the undescribed taxa in Orange County to be adequately conserved, and it is not discussed further; however, once the taxonomy of the plants in the Santa Ana Mountains is clarified, this may need to be re-evaluated.

Development:
At the time of the 1997 listing, urban development in the Santa Monica Mountains was an important concern. Development continued to be identified as a threat in the 1999 recovery plan, the 2009 5-year review, 2013 surveys (Dorsey et al. 2013), and CNDDB (2021). *Dudleya cymosa* subsp. *agourensis* is most threatened by development, since 40% of its occurrences are on private land (Dorsey *et al*. 2013 p. 9). *Dudleya cymosa* subsp. *ovatifolia* is completely on California State Park land and is protected from development.

***Illegal collecting*:**
Illegal collecting was also identified as a threat at the 1997 listing, the 2009 5-year review, and recent surveys (Guilliams and Hasenstab-Lehman 2021 p. 46). However, even with a recent surge of *Dudleya* poaching in California (McConnell 2019), collecting of *Dudleya cymosa* subsp. *agourensis* is thought to be minor, if it happens at all (Guilliams and Hasenstab-Lehman 2021 p. 46), and there no evidence of *Dudleya cymosa* subsp. *ovatifolia* collecting.

Recreation:
Recreational rock climbing has been recognized as a threat to *Dudleya cymosa* subsp. *ovatifolia* at EO1 at Malibu Creek (Service 2009, Dorsey *et al.* 2013 pp. 27-28, Guilliams and Hasenstab-Lehman 2021 p. 46), with plants sometimes cleared away to make cleaner climbing routes. Other more general recreational activities, particularly developed and social trail use, have resulted in *Dudleya cymosa* subsp. *agourensis* being trampled in some areas (Dorsey *et al.* 2013 p. 18, Guilliams and Hasenstab-Lehman 2021 p. 41, CNDDB 2021), but this is a minor effect.

Small population size effects:
The 2009 5-year review recognized the susceptibility of *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis* occurrences to stochastic extirpation or extinction. Given the small number of occurrences and their small population sizes (Table 1), this threat remains.

Hybridization:
Possible hybridization between *Dudleya cymosa* subsp. *agourensis* and *Dudleya lanceolata* was recently noted by Guilliams and Hasenstab-Lehman (2021 p. 46). They reported that the amount of contact between the taxa was low, and the overall effects of genetic dilution of *Dudleya cymosa* subsp. *agourensis* by *Dudleya lanceolata* appear low.

Non-native plants:
Beginning with the 2009 5-year review, non-native plants have been recognized as a possible threat to both *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis* (Dorsey *et al.* 2013 p. 18-19, Guilliams and Hasenstab-Lehman 2021 p. 46, CNDDB 2021). For *Dudleya cymosa* subsp. *agourensis* these are annual grasses, such as *Bromus rubens* and *Bromus diandrus*, and for *Dudleya cymosa* subsp. *ovatifolia* these are various horticultural escapes. For both *Dudleya* taxa, the current direct effects of competition are thought to be minor because the non-natives generally occur adjacent to, not among, the *Dudleya* plants. For *Dudleya cymosa* subsp. *agourensis*, the easily ignited non-native grasses could possibly increase the risk of fire. Additionally, grasses can support the future development of soil and woody vegetation that could also compete with the *Dudleya* and burn hotter than grasses, potentially causing greater damage in a fire.

Fire:
In the 2009 5-year review, we identified fire as a potential threat to both *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis*. Fire increased as a concern after the 2013 Springs Fire, which showed that a fire could effectively eliminate most of the individuals of a very narrowly distributed *Dudleya* species (*Dudleya verityi*) in similar habitat (Dorsey *et al.* 2013 p. 9).

In late 2018, the Woolsey fire burned over almost all the occurrences of *Dudleya cymosa* subsp. *agourensis* and the Malibu Creek occurrence of *Dudleya cymosa* subsp. *ovatifolia*. Post-burn surveys in 2020 (Guilliams and Hasenstab-Lehman 2021 pp. 34, 41) showed that the burn severities were low for the burned occurrences, and that the plants were not affected much by the fire, with relatively high plant numbers at the burned occurrences. It appears that *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis* were resilient to the Woolsey fire severity conditions.

Climate change:
In the 2009 5-year review, we identified climate change as a potential threat to *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis*. Since then, climate change has become more important, with more detailed projections of what changes could occur.

Current regional climate change models predict substantial changes by the end the century for the area in which *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis* are located (Hall *et al.* 2018 pp. 9-19). These changes include an increase in annual mean temperature by 5^{o}F, hotter maximum temperatures by 10^{o}F, increased variability of rainfall and extreme rainfall and drought events, and increased wildfire. Overall, the region will be hotter and drier.

While it is not known how *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis* will respond to these changing conditions, there are some studies that are suggestive. Dorsey and Wilson (2011 pp. 1109-1111) found that smaller, rarer *Dudleya* species have a lower tolerance for hot, dry conditions compared with the more common species in the Santa Monica Mountains. This could lead to local extirpations of rare species, or gradual shifts in range to areas that are still cool and moist enough to support rarer *Dudleya* populations.

Another prediction with increasing annual temperatures in California is an increase of non-native annual grasses (Sandel and Dangremond 2012 entire). If annual grass cover increases around *Dudleya cymosa* subsp. *agourensis*, both the competitive effects of the grass and the increased flammability could negatively impact the taxon. In this case, there could be a synergistic effect that compounds several threats- climate change favors non-native plants which increases fire risk.

Summary of threats:
The identified threats for *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis* include urban development, illegal collecting, recreational activities, small population size effects, hybridization, non-native plants, fire, and climate change.

Illegal collecting, and hybridization are currently of minor concern, but illegal collecting could increase in the future. Most recreational activities have little impact on most occurrences of *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis*, but one occurrence of *Dudleya cymosa* subsp. *ovatifolia* (EO10) is impacted by recreational climbing. Currently the threat of small population size effects is recognized, but its magnitude is unknown.

Urban development remains a threat for some of the occurrences of *Dudleya cymosa* subsp. *agourensis* along the north edge of the western Santa Monica Mountains, because the occurrences are on private land. The threats of non-native plants, wildfire, and climate change are linked, and may be more important for *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis* in the future. Increasingly hot and dry conditions may alter habitat, and favor shifts in vegetation that promote burning. While a recent fire has been shown to have minor effects on *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis*, future fires may have different severity and effects under a changing climate.

EVALUATION OF DELISTING CRITERIA:

The current status of delisting criteria in the 1999 Recovery Plan (Service 1999, p. 42) is as follows:

Delisting criteria for *Dudleya cymosa subsp. ovatifolia*

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

   This criterion has not been met. Some populations remain on private land without protection.

2. *All current populations (including seedbanks) are shown through monitoring to be self-sustaining over a minimum of 10 years.*

   This criterion has not been met. Comprehensive repeat surveys of all populations have not been conducted, although the efforts of Guilliams and Hasenstab-Lehman (2021) provide a good starting baseline.

CONCLUSION:

The evaluation of threats affecting the species under the factors in 4(a)(1) of the Act and the analysis of the status of the species in our 2009 5-year review remain accurate reflections of the species current status. After reviewing the best available scientific information, we conclude that *Dudleya cymosa* subsp. *ovatifolia* (including the subsp. *agourensis* and the undescribed Orange County taxon or taxa) remains a threatened species.

RECOMMENDATIONS FOR FUTURE ACTIONS:

1. Regularly monitor *Dudleya cymosa* subsp. *ovatifolia* and *Dudleya cymosa* subsp. *agourensis* populations to evaluate population trends.
2. Improve the completeness of coverage of *Dudleya cymosa* subsp. *ovatifolia*, *Dudleya cymosa* subsp. *agourensis*, and undescribed taxa in conservation seed banks, with more occurrences over more years.
3. Confirm recent taxonomic changes, including the undescribed taxa in the Santa Ana Mountains, and recognize the segregation of the recognized undescribed taxa, *Dudleya cymosa* subsp. *ovatifolia*, and *Dudleya cymosa* subsp. *agourensis.*
4. Determine with more detail the distribution and status of all taxa in the Santa Ana Mountains that were considered part of *Dudleya cymosa* subsp. *ovatifolia* since listing.

APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approved STEPHEN HENRY Digitally signed by STEPHEN HENRY Date: 2021.08.30 13:33:50 -07'00'

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