

State of California
Natural Resources Agency
Department of Fish and Wildlife

REPORT TO THE FISH AND GAME COMMISSION

EVALUATION OF A PETITION FROM KATHLEEN ROCHE
TO LIST SHASTA SNOW-WREATH AS ENDANGERED UNDER THE CALIFORNIA
ENDANGERED SPECIES ACT



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Prepared by
California Department of Fish and Wildlife

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I. Executive Summary

On September 30, 2019, Ms. Kathleen Roche (Petitioner) submitted a Petition (Petition) to the Fish and Game Commission (Commission) to list Shasta snow-wreath (*Neviusia cliftonii*) as endangered pursuant to the California Endangered Species Act (CESA), Fish and Game Code Section 2050 *et seq.*

The Commission referred the Petition to the Department of Fish and Wildlife (Department) in accordance with Fish and Game Code Section 2073. (Cal. Reg. Notice Register 2019, No. 15-Z, p. 575.) Pursuant to Fish and Game Code Section 2073.5 and Section 670.1, subdivision (d)(1), of Title 14 of the California Code of Regulations, the Department prepared this Petition evaluation report (Petition Evaluation). The purpose of the Petition Evaluation is to assess the scientific information in the Petition in relation to other relevant and available scientific information possessed or received by the Department during the evaluation period, and to recommend to the Commission whether the Petition should be accepted and considered.

After reviewing the Petition and other relevant information, the Department determined the following:

- Population Trend. Scientific information on Shasta snow-wreath's population trends is limited; however, the Petition presents evidence that populations of Shasta snow-wreath were reduced by the filling of Shasta Dam in 1948. The Petition contains sufficient information on the population trend of Shasta snow-wreath.
- Range. The Petition contains sufficient information on Shasta snow-wreath's geographic range.
- Distribution. The Petition contains sufficient scientific information on Shasta snow-wreath's distribution.
- Abundance. The Petition contains sufficient scientific information on Shasta snow-wreath's abundance.
- Life History. The Petition contains sufficient information on the known life history and ecology of Shasta snow-wreath.
- Kind of Habitat Necessary for Survival. The Petition contains sufficient information regarding the kind of habitat necessary for Shasta snow-wreath's survival.
- Factors Affecting the Ability to Survive and Reproduce. The Petition contains sufficient information to indicate that the long-term survival of Shasta snow-wreath is threatened by a number of ongoing and future threats such as habitat modification and loss, overutilization, disease, and other factors.

- Degree and Immediacy of Threat. The Petition discusses several projects that threaten the continued existence of Shasta snow-wreath, including the proposed project to raise Shasta Dam and several ongoing vegetation management projects. The Petition contains sufficient information to indicate that threats to the long-term survival of Shasta snow-wreath will continue or potentially worsen in the future.
- Impact of Existing Management Efforts. The Petition contains sufficient information to indicate that existing management efforts do not adequately protect the Shasta snow-wreath from threats to its long-term survival.
- Suggestions for Future Management. The Petition contains sufficient information regarding management suggestions that may aid in conserving Shasta snow-wreath.
- A Detailed Distribution Map. The Petition contains a detailed map of the distribution of Shasta snow-wreath.
- Availability and Sources of Information. The Petition contains sufficient information on the availability and sources of information used in the Petition.

The Department's Petition Evaluation is focused on the scientific information provided in the Petition as well as additional scientific information the Department possesses, or has knowledge of, regarding Shasta snow-wreath populations.

In completing its Petition Evaluation, the Department finds there is sufficient information to indicate the petitioned action may be warranted and recommends the Commission accept and consider the Petition.

II. Introduction

A. Candidacy Evaluation

The Commission has the authority to list a native species or subspecies as threatened or endangered under CESA. (Fish & G. Code, §§ 2062, 2067, 2070.) The listing process is the same for species and subspecies. (Fish & G. Code, §§ 2070-2079.1.)

CESA sets forth a two-step process for listing a species as threatened or endangered. First, the Commission determines whether to designate a species as a candidate for listing by evaluating whether the petition provides "sufficient information to indicate that the petitioned action may be warranted." (Fish & G. Code, § 2074.2, subd. (e)(2).) If the petition is accepted for consideration, the second step requires the Department to produce, within 12 months of the Commission's acceptance of the petition, a peer reviewed report based upon the best scientific information available that advises the Commission on whether the petitioned action is warranted. (Fish & G. Code, § 2074.6.)

Finally, the Commission, based on that report and other information in the administrative record, then determines whether the petitioned action to list the species as threatened or endangered is warranted. (Fish & G. Code, § 2075.5.)

A petition to list a species under CESA must include “information regarding the population trend, range, distribution, abundance, and life history of a species, the factors affecting the ability of the population to survive and reproduce, the degree and immediacy of the threat, the impact of existing management efforts, suggestions for future management, and the availability and sources of information. The petition shall also include information regarding the kind of habitat necessary for species survival, a detailed distribution map, and any other factors that the petitioner deems relevant.” (Fish & G. Code, § 2072.3; see also Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1).) The range of a species for the Department’s petition evaluation and recommendation is the species’ California range. (*Cal. Forestry Assn. v. Cal. Fish and Game Com.* (2007) 156 Cal.App.4th 1535, 1551.)

Within ten days of receipt of a petition, the Commission must refer the petition to the Department for evaluation. (Fish & G. Code, § 2073.) The Commission must also publish notice of receipt of the petition in the California Regulatory Notice Register. (Fish & G. Code, § 2073.3.) Within 90 days of receipt of the petition (or 120 days if the Commission grants an extension), the Department must evaluate the petition on its face and in relation to other relevant information and submit to the Commission a written evaluation report with one of the following recommendations:

- Based upon the information contained in the petition, there is not sufficient information to indicate that the petitioned action may be warranted, and the petition should be rejected; or
- Based upon the information contained in the petition, there is sufficient information to indicate that the petitioned action may be warranted, and the petition should be accepted and considered.

(Fish & G. Code, § 2073.5, subds. (a)-(b).) The Department’s candidacy recommendation to the Commission is based on an evaluation of whether the petition provides sufficient scientific information relevant to the petition components set forth in Fish and Game Code Section 2072.3 and the California Code of Regulations, Title 14, Section 670.1, subdivision (d)(1).

In *Center for Biological Diversity v. California Fish and Game Commission* (2008) 166 Cal.App.4th 597, the California Court of Appeals addressed the parameters of the Commission’s determination of whether a petitioned action should be accepted for consideration pursuant to Fish and Game Code Section 2074.2, subdivision (e), resulting in the species being listed as a candidate species. The court began its

discussion by describing the standard for accepting a petition for consideration previously set forth in *Natural Resources Defense Council v. California Fish and Game Commission* (1994) 28 Cal.App.4th 1104:

As we explained in *Natural Resources Defense Council*, “the term ‘sufficient information’ in section 2074.2 means that amount of information, when considered with the Department’s written report and the comments received, that would lead a reasonable person to conclude the petitioned action may be warranted.” The phrase “may be warranted” “is appropriately characterized as a ‘substantial possibility that listing could occur.’” “Substantial possibility,” in turn, means something more than the one-sided “reasonable possibility” test for an environmental impact report but does not require that listing be more likely than not.

(*Center for Biological Diversity, supra*, 166 Cal.App.4th at pp. 609-10 [internal citations omitted].) The court acknowledged that “the Commission is the finder of fact in the first instance in evaluating the information in the record.” (*Id.* at p. 611.) However, the court clarified:

[T]he standard, at this threshold in the listing process, requires only that a substantial possibility of listing could be found by an objective, reasonable person. The Commission is not free to choose between conflicting inferences on subordinate issues and thereafter rely upon those choices in assessing how a reasonable person would view the listing decision. Its decision turns not on rationally based doubt about listing, but on the absence of any substantial possibility that the species could be listed after the requisite review of the status of the species by the Department under [Fish and Game Code] section 2074.6.

(*Ibid.*)

B. Petition History

On September 30, 2019, the Petitioner submitted the Petition to the Commission. On October 10, 2019, the Commission referred the Petition to the Department for evaluation. On November 6, 2019, the Department requested a 30-day extension of the 90-day Petition evaluation period. The Commission approved the extension request at its December 11, 2019 meeting. The Department submitted this Petition Evaluation to the Commission on February 3, 2020.

The Department evaluated the scientific information presented in the Petition as well as other relevant information the Department possessed at the time of review. The Commission did not receive new information from the public during the Petition

Evaluation period pursuant to Fish and Game Code Section 2073.4. Pursuant to Fish and Game Code Section 2072.3 and Section 670.1, subdivision (d)(1), of Title 14 of the California Code of Regulations, the Department evaluated whether the Petition included sufficient scientific information regarding each of the following petition components to indicate whether the petitioned action may be warranted:

- Population trend;
- Range;
- Distribution;
- Abundance;
- Life history;
- Kind of habitat necessary for survival;
- Factors affecting the ability to survive and reproduce;
- Degree and immediacy of threat;
- Impact of existing management efforts;
- Suggestions for future management;
- Availability and sources of information; and
- A detailed distribution maps.

C. Overview of Shasta Snow-Wreath Ecology

Shasta snow-wreath (*Neviusia cliftonii*) is a dicot shrub in the rose family (Rosaceae) that is native to California and is endemic (limited) to northern California. Shasta snow-wreath is one of only two species in the genus *Neviusia*. The other species is *Neviusia alabamensis*, a rare endemic of the southeast United States. The species was first described by Shevock et al. (1992). Shasta snow-wreath is found exclusively in western Shasta County around the perimeter of Shasta Lake in northern California and is known from a total of 24 occurrences. Eighteen of the occurrences are on federal land, and six are partially or completely on non-federal land (private or other).

Shasta snow-wreath was not known to science until 1992, when it was discovered northeast of Redding, California and described as a new species. Shasta snow-wreath likely remained unrecognized because its flowers, the most distinguishing feature, only appear for a week to ten days in late April or early May. When not in flower, the wiry, deciduous shrub with soft, tooth-edged leaves resembles common shrubs such as ocean spray (*Holodiscus discolor*) and ninebark (*Physocarpus capitatus*) (Shevock et al. 1992).

Another factor that helped Shasta snow-wreath remain undiscovered for so long is that it grows in places dominated by poison oak (*Toxicodendron diversilobum*), making it difficult to access, and its range is far from any university and in a geographic area that

is poorly explored (Shevock et al. 1992). There are no herbarium specimens of Shasta snow-wreath that were collected before 1992 (Roche 2019).

The inflorescence of Shasta snow-wreath is an umbel-like cluster of three to five flowers. Each flower is a ball of approximately 50 long, whiskery white stamens that are each about half a centimeter long. There are sometimes white petals surrounding the stamens, but the petals are often absent (Shevock et al. 1992). The reproductive biology of Shasta snow-wreath is poorly understood. It is unknown if seeds can be produced by selfing (fertilization by pollen from the same plant) or if cross-pollination (fertilization by pollen from another plant) is necessary. It is also not known if pollination occurs via wind or by insects, but from the structure of the flowers, it appears that Shasta snow-wreath might be wind-pollinated (Roche 2019).

The Petition states that there have been no observations of seedlings of Shasta snow-wreath, and little is known about its life-cycle stages, time from seedling to maturity, or longevity of individual plants. Shasta snow-wreath is presumed to have originated during the Eocene tertiary geological period (56 to 33.9 million years ago), and is thought to have been more widespread (DeVore et al. 2004, 2005; DeVore and Pigg 2007). Species and genera with ancient origins that once had a more continuous and widespread distribution are regarded as “relicts”. Available data suggest that Shasta snow-wreath is a relict, long-lived, clonally propagated shrub that occasionally produces seeds, apparently from sexual reproduction, but the seeds have not been observed germinating in the wild, and propagation attempts have been unsuccessful (Ertter 1993; Stebbins 1993).

III. Sufficiency of Scientific Information to Indicate the Petitioned Action May Be Warranted

The Petition components are evaluated below, with respect to Fish and Game Code Section 2072.3 and Section 670.1, subdivision (d)(1), of Title 14 of the California Code of Regulations.

A. Population Trend

1. Scientific Information in the Petition

The Petition discusses population trend for Shasta snow-wreath under the “Population Status” section on pages 20 to 21. The Petition indicates that Shasta snow-wreath is presumed to have been more widespread, and populations more connected along river corridors. The filling of Shasta Lake in 1948 likely inundated many populations because several populations currently reach their lower limit at the edge of Shasta Lake (Lindstrand and Nelson 2006; DeWoody et al. 2012). Shasta snow-wreath has only been known to science since 1992, so information on population trends of the likely

long-lived shrub is limited. Monitoring was initiated for Shasta snow-wreath in 2011, and population data was collected between 2011 and 2013. Monitoring data collected from this study provides a baseline for monitoring future population trends (Jules et al. 2017).

2. Conclusion

Scientific information on Shasta snow-wreath's population trends is limited; however, the Petition presents evidence that populations were likely reduced by the filling of Shasta Lake in 1948. The Petition contains sufficient information on population trends of Shasta snow-wreath.

B. Geographic Range

1. Scientific Information in the Petition

Information regarding geographic range of Shasta snow-wreath appears on pages 10 through 12, and page 21 of the Petition. Shasta snow-wreath is endemic to California, occurring only near Shasta Lake in Shasta County. The total range covers about 250 square miles. The Petition indicates that Shasta snow-wreath is presumed to have been more widespread before the filling of Shasta Lake in 1948 because many populations of Shasta snow-wreath reach their lower limit at the full pool line of Shasta Lake (Lindstrand and Nelson 2006; DeWoody et al. 2012). The Petition also indicates that Shasta snow-wreath is likely unable to expand its range due to its relict status, lack of observed sexual reproduction, and topographic limitations and associated climate differences.

2. Conclusion

The Petition includes sufficient information to describe Shasta snow-wreath's geographic range.

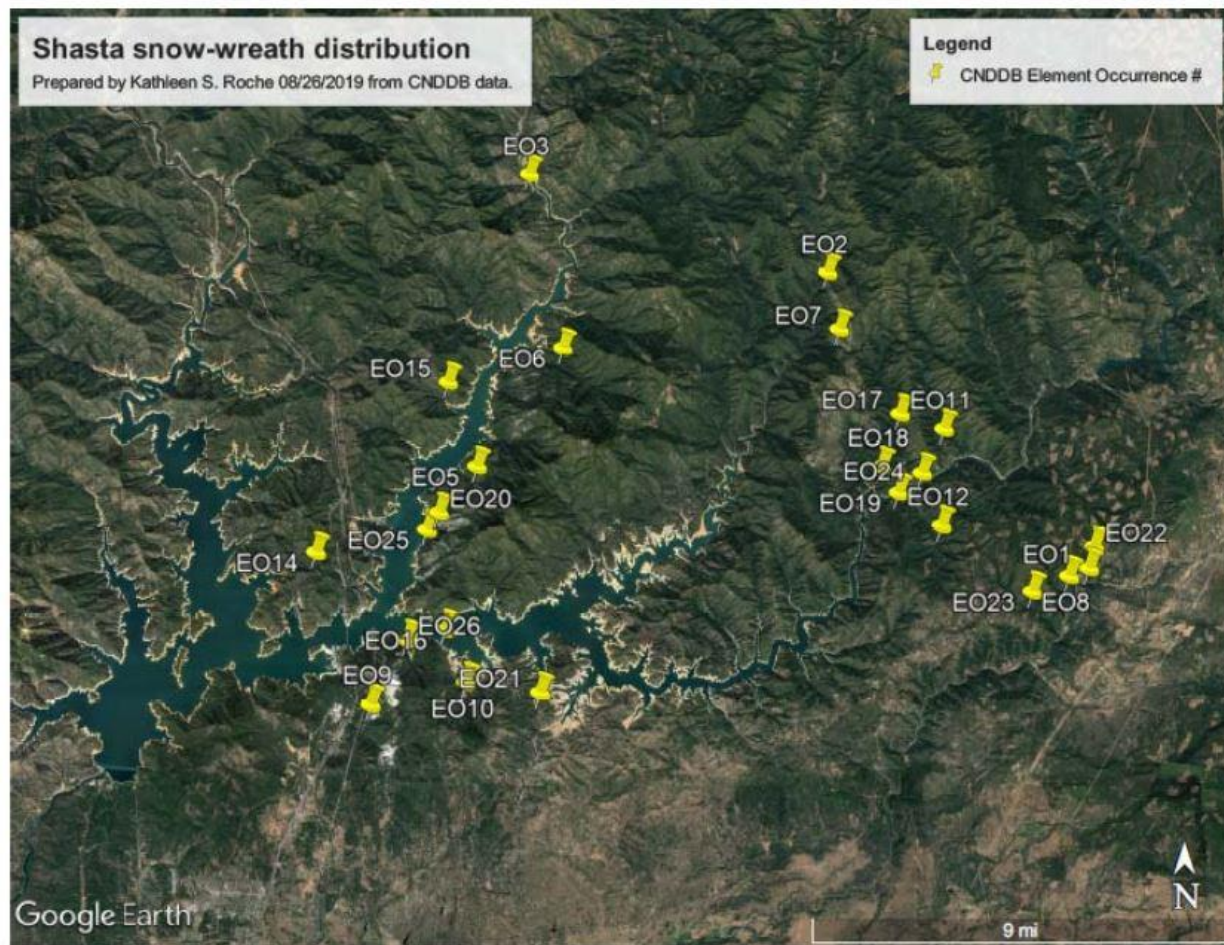
C. Distribution

1. Scientific Information in the Petition

The Petition discusses current and historic distribution on pages 10 through 14. There are 24 documented element occurrences (EOs) of Shasta snow-wreath in the California Natural Diversity Database (CNDDDB) (CNDDDB 2019; Roche 2019). Extensive surveys for Shasta snow-wreath within its known distribution and beyond took place between 1992 and 2016 (Roche 2019). The Petition indicates it is unlikely that many more additional populations of Shasta snow-wreath will be discovered since much of its suitable habitat has been extensively searched.

The Petition provides a map of all known occurrences of Shasta snow-wreath on page 12 (Petition Figure 2), which illustrates the distribution of the species. The map is included below as Figure 1.

Figure 1. Shasta Snow-Wreath Distribution Map (Roche 2019, Figure 2)



Source: Kathleen S. Roche 2019a. Prepared from Google Earth Image 05/11/19 and CNDDDB Element Occurrences 2018.

2. Other Relevant Scientific Information

The distribution of occurrences shown in Figure 1 closely matches the locations of occurrences of Shasta snow-wreath in the CNDDB (CNDDB 2019).

3. Conclusion

The information provided in the Petition on distribution of Shasta snow-wreath is consistent with other information available to the Department from occurrence records. The Petition contains sufficient scientific information to describe Shasta snow-wreath's distribution.

D. Abundance

1. Scientific Information in the Petition

The Petition discusses abundance in the “Natural History” section on pages 26 through 28. Shasta snow-wreath appears to be a clonally propagating shrub that is capable of significant vegetative reproduction. Although this species occasionally produces seeds, its seeds are not yet confirmed to germinate in the wild or in attempts to propagate them (Ertter and Shevock 1993). The Petition indicates that all occurrences have some degree of genetic relatedness and states that known occurrences of Shasta snow-wreath may be one or several very large clones. For clonal species, the term “genet” is used to describe a group of genetically identical individuals that all originate vegetatively from a single ancestor. Each unit (seemingly individual plant) is referred to as a “ramet”. Above ground, these ramets most often appear to be distinct individuals, but they may all be clones of the same plant. The Petition describes a study conducted in 2009 that sampled 21 subpopulations of Shasta snow-wreath to investigate the number of genetic individuals (genets) in each subpopulation. In this study, 21 subpopulations from 17 CNDDDB occurrences were sampled (DeWoody et al. 2012; CNDDDB 2019). The results of the study indicated that five subpopulations of Shasta snow-wreath were composed of a single genet each. The average number of genets per subpopulation was 3.14, and there was a maximum of 15 genets identified in a single subpopulation (DeWoody et al. 2012; Roche 2019). Some genets occurred in multiple subpopulations (DeWoody et al. 2012). See Table 1, below, for a summary of genets identified per sampled subpopulation.

Table 1. Number of Genets Per Shasta Snow-Wreath Subpopulation as Estimated in DeWoody et. al. (2012)

CNDDDB EO #	Name of Sampling Location	Genets
1	Cedar Creek	6
2	Squaw Creek	2
3	Ellery Creek	2
3	South Ellery Creek	4
5	Curl Creek	4
6	Campbell Creek	2
7	Low Pass	4
10	Cove Creek	2
10	South of Cove Creek	4
11	Ripgut Creek	2
12	Stein Creek	15
14	Waters Gulch	2
15	Keluche Creek	2
16	Blue Ridge East	1
16	Blue Ridge Mid	1
16	Blue Ridge West	1
17	Flat Creek	3
18	Brock Creek	3
19	West of Stein Creek	2
20	Shasta Caverns	1
21	Jones Valley	1

2. Other Relevant Scientific Information

The Department’s CNDDDB contains information on population size for most occurrences of Shasta snow-wreath. It is assumed that population estimates in the CNDDDB represent the number of ramets at each occurrence. Estimates of population size range from ten to thousands of plants (CNDDDB 2019). Information on population size from the CNDDDB is summarized in Table 2, below. Table 2 also includes information on threats to each occurrence as presented in the Petition. Additional discussion of threats is included in the Factors Affecting Ability to Survive and Reproduce section of this report.

Table 2. Summary of Occurrence Information and Threats (adapted from Table 1 in Petition). Occurrence Information as provided in the CNDDDB (2019), and Threats as provided in Table 1 of the Petition (Roche 2019).

CNDDDB EO #	Size (acres)	Occurrence Information (CNDDDB 2019)	Ownership	Threats (as stated in Table 1 in the Petition)
1	18	Dominant understory shrub along with western poison oak (<i>Toxicodendron diversilobum</i>).	Non-federal	Potential mining; the Hosselkus Limestone Formation is a high-quality source material for cement production. Fires. Inferred threats: climate change.
2	30	Dominant understory shrub in association with western poison oak (<i>Toxicodendron diversilobum</i>).	Federal	Not specified in EO record. In dense vegetation near limestone outcrop. Inferred threats: physical removal through mining or road construction, wildfire, climate change.

CNDDB EO #	Size (acres)	Occurrence Information (CNDDB 2019)	Ownership	Threats (as stated in Table 1 in the Petition)
3*	71	Many thousands of plants in 1993; 100-200 plants on the east side of Gilman Road in 2010; Unknown Number in 2007 and 2014	Federal	Surrounded by invasive plants (<i>Rubus armeniacus</i> and <i>Cytisus scoparius</i>) in 1993. Burned over in Hirz fire 2018. Inferred threats: invasive plants, wildfire, climate change.
5	57	2000-3000 plants observed in the 2 western polygons combined in 1993. 50 plants observed in far eastern polygon and >500 seen in far western polygon in 2010	Federal	Not specified in EO record. Inferred threats: wildfire, climate change.
6	8	Greater than 1000 plants observed in 1993; 3000 plants observed in 2010; unknown number observed in 2014	Federal	Possibly threatened by logging in 1993. Road maintenance, raised lake level, and noxious weed invasion in 2010.
7	72	Thousands of plants observed in 1993	Federal	Occurrence is found near a jeep trail. Inferred threats: physical removal, wildfire, climate change.
8	9	1000 plants observed in 1996. Mostly small, widely spaced plants compared to other occurrences.	Federal and Private	Not specified in EO record. Inferred threats: wildfire, climate change.
9	0	No information on population size	Non-federal	Close to mining and roads. Inferred threats: physical removal, sedimentation, invasive species.
10	14	Approximately 20-50 plants seen in 2003. Thousands of plants observed in 2006. Unknown number observed in 2009 and 2014.	Federal	Not specified in EO. Inferred threats: inundation from Shasta Lake, wildfire, climate change.
11	2	Approximately 100 plants seen in 2003	Federal	Not specified in EO. Inferred threats: inundation from Shasta Lake, wildfire, climate change.
12**	57	2 northern polygons: extensive population with thousands of plants seen in 2003, unknown number of plants observed in 2004, 2009, and 2014. Remaining polygons had thousands of plants in 2010	Federal and Private	Timber harvest proposed for area on private land in 2010 but protection measures will be used. Inferred threats wildfire, climate change, invasive species.
14	28	Large population seen in 1994. Unknown number observed during other years (most recently in 2012).	Federal	Previous trail construction probably damaged/destroyed some plants (2001). Scotch broom is encroaching (2010).
15	2	500-1000 plants seen in 2003. Unknown number of plants observed in 2004 and 2014	Federal	Not specified in EO. Inferred threats: inundation from Shasta Lake, wildfire, climate change.
16	7	In 2003, thousands of plants seen at N colony and 250-350 seen at S colony. Unknown number of plants observed in N and S colonies in 2004. 20-30 plants observed in middle colony in 2009. Unknown number of plants across site in 2014.	Federal	Not specified in EO. Inferred threats: inundation from Shasta Lake, wildfire, climate change.

* Includes former EO #4.

** Includes former EO #13

CNDDDB EO #	Size (acres)	Occurrence Information (CNDDDB 2019)	Ownership	Threats (as stated in Table 1 in the Petition)
17	7	1000's of plants observed in 2007.	Federal	Not specified in EO. Inferred threats: wildfire, climate change, possible disturbance from off-highway vehicles.
18	5	100+ plants observed in 2004. Unknown number of plants observed in 2014.	Federal	Not specified in EO. Inferred threats: inundation from Shasta Lake, wildfire, climate change.
19	10	1000's of plants observed in 2006.	Federal	Not specified in EO. Inferred threats: located in dense vegetation, wildfire, invasive species, climate change.
20	2	Northern polygon: fewer than 100 plants observed in 2007, unknown number of plants observed in 2014. Southern polygon: 12 plants observed in 2014.	Federal	Not specified in EO. Inferred threats: dense vegetation, wildfire, invasive species, climate change.
21	4	10-15 plants observed in one colony and 100-200 plants observed in the other colony in 2010. Unknown number of plants observed in 2012 and 2014.	Federal	Not specified in EO. Inferred threats: roads, wildfire, invasive species, climate change.
22	3	Total number of individuals difficult to estimate due to very dense growth along creek; likely 500-1000 shrubs over about 0.69 acre in 2012.	Private	Plants are outside of the timber harvest unit and in the future will be protected within the watercourse and lake protection zone.
23	38	7100+ plants observed in 2012; difficult to determine number of plants since population is very large with some dense clumps. 2500+ estimated in 2013. 5000+ estimated in 2014. Plants were not continuous and were patchy in portions of site.	Private	Portions of site may be threatened by blackberries choking out <i>Neviusia</i> . Majority of population outside harvest unit.
24	1	20-30 plants observed in 2015; small scattered population.	Federal	Not specified in EO. Inferred threats: inundation from Shasta Lake, wildfire, climate change.
25	8	In 2014, northern polygon had 1600-2150 plants and southern polygon had 100-125 plants.	Federal	Not specified in EO. Inferred threats: wildfire, invasive species, climate change, possibly inundation.
26	1	150-200 plants observed in 2015.	Federal	Not specified in EO. Inferred threats: mining, wildfires, invasive species, climate change.

3. Conclusion

The Petition contains sufficient scientific information on Shasta snow-wreath's abundance.

E. Life History

1. Scientific Information in the Petition

The Petition discusses the life history of Shasta snow-wreath on pages 21 through 31. The Petition describes Shasta snow-wreath as an endemic, relict, long-lived, clonally

propagating shrub in the rose family (Rosaceae). Shasta snow-wreath occasionally produces seeds, apparently from sexual reproduction, but seeds have not been confirmed to germinate in the wild or in attempts to propagate them (Ertter and Shevock 1993). Little is known about the reproductive biology of Shasta snow-wreath. It is unknown if pollination occurs via wind or by insects, but from the structure of the flowers, it appears that Shasta snow-wreath may be wind-pollinated. It is not known if the seeds are produced from selfing (fertilization by pollen from the same plant) or from cross-pollination (fertilization by pollen from another plant). There are no recorded observations of insects visiting blossoms of Shasta snow-wreath, and Ertter and Shevock (1993) indicate that the blossoms have no scent. There have been no observations of seedlings of Shasta snow-wreath, and little is known about its life-cycle stages, time from seedling to maturity, or longevity of individual plants (Roche 2019).

2. Conclusion

The Petition presents sufficient information on the known life history of Shasta snow-wreath.

F. Kind of Habitat Necessary for Survival

1. Scientific Information in the Petition

The Petition describes Shasta snow-wreath habitat on pages 33 through 37. Shasta snow-wreath grows in the dense understory of black oak (*Quercus kelloggii*) and yellow pine (*Pinus ponderosa*) dominated mixed conifer forests and foothill pine (*Pinus sabiniana*) and blue oak (*Quercus douglasii*) woodland around Shasta Lake north of Redding, California (Shevock et al. 1992; Lindstrand and Nelson 2005a, 2005b; Jules et al. 2017; CNDDDB 2019). Shasta snow-wreath occupies non-wetland sites on lower slopes of steep mountain valleys on various aspects and occurs in riparian sites within the yellow pine forest community (Calflora 2019). The Petition provides a list of plant species that grow in association with Shasta snow-wreath on pages 33 through 35.

The Petition indicates that Shasta snow-wreath originally was thought to occur only on limestone but is now documented as occurring on other substrates (Lindstrand and Nelson 2005a; Shevock et al. 2005; Lindstrand and Nelson 2006).

The Petition indicates that the area of western Shasta County where Shasta snow-wreath occurs experiences a Mediterranean climate with hot, dry summers and wet, cool winters. Winter temperatures at lower elevations are mostly above freezing, and summer temperatures are very high. Mean annual precipitation varies from approximately 70 inches in the upper portions of the watersheds to nearly 40 inches at the lower end. About 90 percent of the precipitation falls between October and April, mostly as rain. Only the highest peaks hold snow into the summer. Summer

thunderstorms are common and can release significant localized rain. These storms can also be dry with conditions that encourage fire ignition and spread from lightning strikes.

2. Conclusion

The Petition presents sufficient information regarding the kind of habitat necessary for Shasta snow-wreath's survival.

G. Factors Affecting the Ability to Survive and Reproduce

1. Scientific Information in the Petition

The Petition discusses the factors affecting Shasta snow-wreath's ability to survive and reproduce on pages 42 through 58 under the Threats section. The Petition identifies the following factors as threats to Shasta snow-wreath: (1) modification or curtailment of habitat or range; (2) overutilization; (3) disease and predation; (4) existing regulatory mechanisms; and (5) other factors. These factors are discussed separately under the headings below.

Modification or curtailment of habitat or range:

Inundation and other disturbances associated with the Proposed Shasta Dam Project.

The Petition indicates that Shasta snow-wreath is threatened by significant destruction, modification, and curtailment of habitat and range as a result of a number of proposed actions. The Petition discusses the proposed U.S. Bureau of Reclamation Action project to raise Shasta Dam as the primary threat to Shasta snow-wreath and its habitat. If implemented, the project at the highest water level would inundate up to an estimated 32,300 acres of land surrounding the existing Shasta Lake, and would destroy known Shasta snow-wreath occurrences and potential habitat, as well as change hydrology and drainage of habitat areas. The Petition indicates that nine occurrences of Shasta snow-wreath will be partly or completely inundated by the proposed raising of Shasta Dam. The Petition also indicates that another eight occurrences would be impacted by other actions associated with raising Shasta Dam, such as relocating roads, bridges, campgrounds, and other facilities. The Petition states that "62 percent of all known occurrences of the plant species" will be affected by raising the Shasta Dam. But the Department's calculations indicated that 71 percent (17 of 24 occurrences) of the known occurrences would be impacted by the Shasta Dam project. The Department contacted the Petitioner to clarify the number of occurrences that would be affected by the Shasta Dam project. The Petitioner confirmed that the Petition correctly states 17 populations would be affected by the raising of Shasta Dam, and indicated that she inadvertently left two more occurrences out of her calculations that would likely be inundated by the Shasta Dam project. With these two additional occurrences included, a total of 19 of 24

occurrences (79 percent) will be affected by the Shasta Dam Project (K. Roche pers. comm. 2019).

Other land management actions. The Petition also discusses other land management actions that may affect Shasta snow-wreath habitat. The Petition notes that habitat may be modified as a result of ongoing management of National Forest System Lands for fire resilience. The Green-Horse Habitat Restoration and Maintenance Project (Green-Horse Project) (Myers 2016) and the Cow Creek Strategic Fuels Reduction Plan Update (Cow Creek Project) (WSRCD 2010) are two fire resilience projects described in the Petition with potential to affect Shasta snow-wreath and associated habitat. The Green-Horse Project includes activities such as: (1) prescribed broadcast burning or under burning; (2) hand thinning and pruning of small trees and brush followed by hand piling and pile burning; and (3) construction of a 7.41 kilometer (4.61 mile) (1.6 hectares [4 acres]) dozer line to assist fire managers in safely conducting prescribed fire. Eight occurrences of Shasta snow-wreath are documented within the Green-Horse Project area (West 2015; Myers 2016; Roche 2019). The Petition indicates that under the selected alternative for the Green Horse project, a low-intensity fire would damage some above-ground portions of individual plants, while underground portions would be unaffected, and plants would recover in the short-term. The Petition further discusses that a low-intensity surface fire would likely indirectly benefit Shasta snow-wreath populations by reducing riparian cover and competition for resources. The Petition indicates that the Cow Creek Project includes proposed fuel breaks that may overlap the distribution of Shasta snow-wreath (WSRCD 2010).

The Petition discusses the Packers Bay Invasive Plant Species Removal Project (Packers Bay Project) (Kennedy 2018) as a land management action that could pose a threat to Shasta snow-wreath. The Packers Bay Project includes removing non-native invasive broom species [Scotch broom (*Cytisus scoparius*), French broom (*Genista monspessulana*), and Spanish broom (*Spartium junceum*)] infestations and re-establishing native vegetation on approximately 112 acres of National Forest System lands. Vegetation removal actions, including use of herbicides, would occur within the known distribution of Shasta snow-wreath (Kennedy 2018), although there are measures in place to protect sensitive species during herbicide application (Kennedy 2018; EPIC 2019), and removal of invasive species could benefit the Shasta snow-wreath (EPIC 2019).

The Petition also states that U.S. Forest Service road and trail maintenance could also threaten Shasta snow-wreath since several populations occur immediately adjacent to roads or trails. Mining, logging, and other development within or adjacent to occurrences on private land could also impact Shasta snow-wreath by destroying habitat and/or introducing invasive species.

Invasive species. The Petition identifies invasive species as a threat to Shasta snow-wreath and its habitat. In addition to threats from the invasive broom species described above, Himalayan blackberry (*Rubus armeniacus*) has been recorded at five populations of Shasta snow-wreath (Jules et al. 2017; CNDDDB 2019). Himalayan blackberry can spread rapidly, competing for resources with native vegetation and can have severe effects on plant community composition and structure (Cal-IPC 2004).

Wildfire. The Petition also discusses wildfire as a potential threat to occurrences of Shasta snow-wreath, but also acknowledges that wildfires may benefit populations of Shasta snow-wreath. The Petition indicates that the Hirz Fire (2018), which burned through one Shasta snow-wreath population, removed above ground portions of Shasta snow-wreath clones, but that resprouting occurred. In addition, the Petition indicates that the California black oak woodlands and Pacific ponderosa pine-Douglas-fir forests where Shasta snow-wreath populations occur exhibit very high departures from historic fire frequencies, and this area historically experienced frequent wildfires with an average fire return rate of 12 years. The Petition notes that restoring a more frequent fire return interval through prescribed burning might benefit Shasta snow-wreath (Jules et al. 2017). Although frequent fire might benefit Shasta snow-wreath, the Petition also indicates that repeat, short-interval fires may push ecosystems into new states, dramatically changing the ecosystem characteristics due to the loss of resilience of the vegetation. The Petition notes that wildfires can also facilitate the reproduction of invasive species. The benefits and threats to Shasta snow-wreath from wildfires are not documented or quantified, but all 24 known occurrences of Shasta snow-wreath could be threatened by wildfire (Roche personal communication 2019).

The Petition also indicates that Shasta snow-wreath may be affected by a loss of suitable habitat in the event of a high-intensity wildfire; however, since Shasta snow-wreath and other riparian species typically grow in moist environments where fire is less able to spread, negative impacts from fire events may not be as severe. If a high-intensity fire altered the hydrologic regime, negative impacts to riparian species such as Shasta snow-wreath would be major and long-term. In addition, high-intensity fire would reduce soil cover (e.g., woody debris, litter, duff), which would adversely impact the structural stability of many plant species. Loss of nutrients stored in the organic layer that are vital for plant growth would also be lost or reduced in a high-intensity fire.

Other habitat factors. The Petition indicates that Shasta snow-wreath occurs in an area known to have unstable soils and landslides. That, coupled with Shasta snow-wreath populations growing in an area of known extreme fire and precipitation events, could result in reductions in occurrences and habitats since the risk of debris flow increases after fires.

Climate change. The Petition states that climate change could threaten the continued existence of Shasta snow-wreath, but it is unknown how resilient Shasta snow-wreath is to changes in temperature or moisture regimes. The Petition states that the paleo climate Shasta snow-wreath endured included warmer and drier conditions as well as colder and wetter conditions than the species currently experiences (Topel et al. 2012), indicating that Shasta snow-wreath may have considerable plasticity or adaptability to different climate regimes. However, the ability of Shasta snow-wreath to move into nearby suitable climate niches is limited due to the steep terrain, human introduced impediments, and limited dispersal capabilities.

Overutilization:

The Petition states that Shasta snow-wreath habitat is currently being overutilized for commercial, recreational, scientific, or educational purposes, and habitat use may increase in the future if the Shasta Dam is raised and brings additional human presence to the area. The Petition indicates that Shasta snow-wreath has been, and likely continues to be, collected by gardeners and botanists for growing in personal gardens and for deposit as pressed and dried herbarium specimens. The Petition also states that Shasta snow-wreath is occasionally available from commercial nurseries.

Disease and predation:

The Petition identifies disease and predation as possible threats to Shasta snow-wreath but indicates that no diseases of Shasta snow-wreath are documented. The Petition cites personal observations by Julie Kierstead Nelson in 2016 that note the appearance of fungi on the leaves of Shasta snow-wreath at one population.

Inadequacy of existing regulatory mechanisms:

The Petition states that the inadequacy of existing regulatory mechanisms is contributing to the threats to Shasta snow-wreath. Shasta snow-wreath is not listed under the California Endangered Species Act or the federal Endangered Species Act (CNDDDB 2019). Shasta snow-wreath is included on the California Department of Fish and Wildlife Special Vascular Plants, Bryophytes, and Lichens List (CDFW CNDDDB 2019) and is currently listed as sensitive by the U.S. Forest Service, Pacific Southwest Region (R5) under the Regional Forester's Sensitive Species List and by the U.S. Bureau of Land Management. Forest Service Sensitive Species are managed to avoid a trend towards federal listing and consist of species identified by the U.S. Forest Service for which population viability is a concern, as evidenced by significant current or predicted downward trends in population numbers or density, and/or a significant current or predicted downward trend in habitat capability that would reduce a species' existing distribution. The Petition indicates that as Forest Plans are updated to the 2012 Planning Rule Standards, the Shasta-Trinity National Forest may or may not include

Shasta snow-wreath in its “species of conservation concern list”. Eighteen of the occurrences are partially or completely located federal lands administered by the U.S. Forest Service or the U.S. Bureau of Land Management. The remaining six occurrences are on non-federal land (private or other).

Other factors:

The Petition discusses pollination and reproduction challenges as other factors that pose threats to Shasta snow-wreath. It is unknown if Shasta snow-wreath is insect- or wind-pollinated. Although achenes (dry, one-seeded fruits) have been observed, the viability of any seeds contained within the achenes is unknown and no seedlings of Shasta snow-wreath have been observed. Germination attempts have been unsuccessful (Ertter and Shevock 1993).

2. Conclusion

The Petition contains sufficient information on the factors affecting the ability of Shasta snow-wreath to survive and reproduce.

H. Degree and Immediacy of Threat

1. Scientific Information in the Petition

The degree and immediacy of threat to Shasta snow-wreath is discussed in the following sections of the Petition: “Executive Summary” on pages 7 and 8, “Threats” on pages 42 through 58, and “Summary and Justification” on page 59. The Petition indicates that the primary threat to Shasta snow-wreath is significant destruction, modification, and curtailment of habitat by the proposed project to raise the height of Shasta Dam and other ongoing projects. The Petition states that other proposed or ongoing vegetation management projects may have both positive and negative effects on this species, and invasive plant species also pose a threat. Overutilization, disease, and predation appear to pose minor threats to Shasta snow-wreath. In addition, the Petition indicates that other factors such as climate change, landslides, and wildfires appear to be minor influences on Shasta snow-wreath survival, but these factors are difficult to quantify.

2. Conclusion

The Petition contains sufficient information on the degree and immediacy of threats to Shasta snow-wreath.

I. Impact of Existing Management Efforts

1. Scientific Information in the Petition

The Petition discusses the impact of existing management efforts under the following sections: “Land Ownership and Management Direction” on page 14, “Conservation Status” on page 17, “Other Land Management Actions” on pages 45 through 49, and “Threats” on pages 56 to 57. As discussed in the Petition, 18 of the 24 known occurrences of Shasta snow-wreath are entirely on National Forest System Lands that are managed by the Shasta Lake Ranger District of Shasta-Trinity National Forest. Many occurrences on National Forest System lands are within the Whiskeytown-Shasta-Trinity National Recreation Area. The management emphasis of the National Recreation Area is to provide recreation associated with the reservoirs. The Petition indicates that such management will promote or is compatible with, and does not significantly impair, public recreation and conservation of scenic, scientific, historic, or other values contributing to public enjoyment.

The Petition indicates that one Shasta snow-wreath occurrence is within the Devil’s Rock-Hosselkus Research Natural Area of the Shasta-Trinity National Forest, which remains in an unmanaged natural state. The Petition indicates that the Research Natural Area status of this area could potentially be revised with the Forest Plan Revision as Forest Plans are updated to the 2012 Planning Rule standards.

The Petition indicates that Shasta snow-wreath is currently listed as sensitive by the U.S. Forest Service, Pacific Southwest Region under the Regional Forester’s Sensitive Species list and by the U.S. Bureau of Land Management for California, and sensitive species are managed to avoid a trend towards federal listing. As Forest Plans are updated to the 2012 Planning Rule standards as described above, the Petition states that the Shasta-Trinity National Forest may, or may not, include Shasta snow-wreath in its list of species of conservation concern.

The Petition also describes ongoing fire resilience and invasive species management projects on National Forest Lands where Shasta snow-wreath is known to occur. The Green Horse, Cow Creek, and Packers Bay projects are described above in the “Factors Affecting the Ability to Survive and Reproduce” section.

Six occurrences of Shasta snow-wreath are partially or completely on non-federal or private lands (CNDDDB 2019) and the Petition indicates that these lands are managed to meet landowner goals.

2. Conclusion

The Petition contains sufficient information in the impacts of existing management efforts.

J. Suggestions for Future Management

1. Scientific Information in the Petition

The Petition suggests future management actions on pages 59 through 61. The Petition recommends the following specific actions:

- Restrict destruction and removal of occurrences, removal of above ground and below ground plant parts, and modification of habitat for Shasta snow-wreath associated with the proposal to raise Shasta Dam to prevent occurrences and habitat from being inundated or destroyed.
- Reduce harmful disturbances to Shasta snow-wreath plants, plant parts, and habitat that is occurring and planned to occur on federal lands.
- Conduct habitat modeling through geographic information systems and field checking to search for other occurrences and to identify the best places for reintroduction.
- Collect and propagate ramets/genets to conserve diversity in potential habitat and at an off-site location using best available science and practices.
- Implement studies on reproduction and pollination using best available science and methodology including studies of seeds and viability.
- Conduct an organized search for seedlings throughout Shasta snow-wreath's distribution.
- Implement ongoing control of invasive species and studies of effectiveness of control.
- Develop State-level conservation agreements with non-federal landowners.
- Support actions to reduce climate change.
- Identify fungal diseases currently affecting this species and determine potential for spread and methods of potential control.

2. Conclusion

The Petition provides sufficient management suggestions that may aid in conserving Shasta snow-wreath.

K. Detailed Distribution Map

1. Scientific Information in the Petition

Page 12 of the Petition provides a map prepared by the Petitioner showing the distribution of Shasta snow-wreath. This map is included as Figure 1 on page 8 of this Petition Evaluation Report.

2. Other Relevant Scientific Information

The distribution of occurrences shown in Figure 1 closely matches the locations of occurrences of Shasta snow-wreath in the CNDDDB (CNDDDB 2019).

3. Conclusion

The Petition provides a detailed map that illustrates the Shasta snow-wreath's distribution.

L. Sources and Availability of Information

1. Scientific Information in the Petition

The "Literature Cited" section of the Petition is on pages 61 through 75. Information sources cited in the Petition include published literature and other sources. The Petitioner provided electronic copies of these documents to the Commission.

2. Other Relevant Scientific Information

The Department used additional sources of scientific information cited in this Petition Evaluation document.

3. Conclusion

The Petition provides sufficient information on the availability and sources of information used in the Petition.

V. Recommendation to the Commission

In completing its Petition Evaluation, the Department has determined the Petition provides sufficient scientific information to indicate that the petitioned action may be warranted for Shasta snow-wreath. Therefore, the Department recommends the Commission accept the Petition for further consideration under CESA.

VI. Literature Cited

- Calflora. 2019. Calflora Taxon Report 5852. Available online: https://www.calflora.org/cgi-bin/species_query.cgi?where-taxon=Neviusia+cliftonii [accessed 5 November 2019].
- [CDFW CNDDDB] California Department of Fish and Wildlife, California Natural Diversity Database. 2019. Special Vascular Plants, Bryophytes, and Lichens List. Quarterly publication (October 2019). 140 pp. Available online: <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=109383&inline> [accessed 7 November 2019].
- [Cal-IPC] California Invasive Plant Council. 2004. *Rubus armeniacus* (Himalayan blackberry). Available online: <https://www.cal-ipc.org/plants/paf/rubus-armeniacus-plant-assessment-form/> [accessed 7 November 2019].
- [CNDDDB] California Natural Diversity Database. 2019. Rarefind 5 [Internet]. California Department of Fish and Wildlife. [version date: 29 September 2019].
- DeVore, M.L., S.M. Moore, K.B. Pigg, and W.C. Wehr. 2004. Fossil *Neviusia* leaves (Rosaceae: Kerrieae) from the lower-middle Eocene of southern British Columbia. *Rhodora* 106:187-209.
- DeVore, M.L., and K.B. Pigg. 2007. A brief review of the fossil history of the family Rosaceae with a focus on the Eocene Okanogan Highlands of eastern Washington State, USA, and British Columbia, Canada. *Plant Systematics and Evolution* 266:45-47.
- DeVore, M.L., K.B. Pigg, W.C. Wehr. 2005. Systematics and phytogeography of selected Eocene Okanogan Highlands plants. *Canadian Journal of Earth Sciences* 42:205-214.
- DeWoody, J., L. Lindstrand III, V.D. Hipkins, and J.K. Nelson. 2012. Population Genetics of *Neviusia cliftonii* (Shasta snow-wreath): Patterns of Diversity in a rare endemic. *Western North America Naturalist* 72:457-472.
- [EPIC] Environmental Protection Information Center. 2019. Documentation of manual treatments. Available online: <https://www.wildcalifornia.org/blog/success-people-power-prevails> [accessed 7 November 2019].
- Ertter, B. 1993. What is snow-wreath doing in California? *Fremontia* published as 22(3):3-4 (now filed as 21(3):3-4). Available online: https://docubase.berkeley.edu/cgi-bin/pl_dochohome?query_src=pl_search&collection=Fremontia&id=165 [accessed 7 November 2019].

- Ertter, B. and J.R. Shevock. 1993. Snow-wreath and its relatives in the garden. In: Shasta snow-wreath: a new genus for California. *Fremontia* 22(3):10-11 (now filed as 21(3):10-11). Available online: https://docubase.berkeley.edu/cgi-bin/pl_dochohome?query_src=pl_search&collection=Fremontia&id=165 [accessed 7 November 2019].
- Faber-Langendoen, D., J. Nichols, L. Master, K. Snow, A. Tomaino, R. Bittman, G. Hammerson, B. Heidel, L. Ramsay, A. Teucher, and B. Young. 2012. NatureServe Conservation Status Assessments: Methodology for Assigning Ranks. NatureServe, Arlington, VA.
- Irwin, W.P. 2003. Correlation of the Klamath Mountains and Sierra Nevada Sheet 1: Map showing accreted terranes and plutons of the Klamath Mountains and Sierra Nevada. U.S. Department of the Interior U.S. Geological Survey. Available online: https://ngmdb.usgs.gov/Prodesc/proddesc_54412.htm [accessed 7 November 2019].
- Jules, E.S., J.I. Jackson, R.J. Butz, and H.M. Kurkjian. 2017. Population Structure and Site Characteristics of the Rare Shasta Snow-Wreath (*Neviusia cliffonii*). *Madroño* 64:116-123.
- Kennedy, A. 2018. Packers Bay Invasive Plant Species Removal Project Decision Notice. United States Department of Agriculture Forest Service Shasta-Trinity National Forest. Available online: https://www.fs.usda.gov/nfs/11558/www/nepa/64917_FSPLT3_4285838.pdf [accessed 7 November 2019].
- Lindstrand III, L., and J.K. Nelson. 2005a. Shasta snow-wreath: New occurrences and habitat associations. *Fremontia* 33(2):24-26.
- Lindstrand III, L., and J.K. Nelson. 2005b. Noteworthy collections. *Madroño* 52:126-127.
- Lindstrand III, L., and J.K. Nelson. 2006. Habitat, geologic, and soil characteristics of Shasta snow-wreath (*Neviusia cliffonii*) populations. *Madroño* 53:65-68.
- Myers, D.R. 2016. Green-Horse project Record of Decision signed November 17, 2016. United States Department of Agriculture (USDA) Forest Service (FS) Shasta-Trinity National Forest. Available online: https://www.fs.usda.gov/nfs/11558/www/nepa/60566_FSPLT3_3906448.pdf [accessed 6 November 2019].
- NatureServe. 2019. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available online: <http://explorer.natureserve.org> [accessed 5 November 2019].
- Roche, K. 2019. Petition to the State of California Fish and Game Commission to List the Shasta Snow-Wreath (*Neviusia cliffonii*) as Endangered Under the California Endangered Species Act. September 30, 2019. 75 pp.

- Shevock, J.R., B. Ertter, and D.W. Taylor. 1992. *Neviusia cliftonii* (Rosaceae: Kerrieae), an intriguing new relict species from California. *Novon* 2:285-289.
- Shevock, J.R., B. Ertter, and D.W. Taylor. 2005. Noteworthy Collections. *Madroño* 52:125-130.
- Stebbins, G.L. 1993. Another step forward in understanding plant evolution. In: Shasta snow-wreath: a new genus for California. *Fremontia* 22:11-13 (now filed as 21(3):11-13). Available online: https://docubase.berkeley.edu/cgi-bin/pl_dochose?query_src=pl_search&collection=Fremontia&id=165 [accessed 7 November 2019].
- Töpel, M, A. Antonelli, C. Yesson, and B. Eriksen. 2012. Past climate change and plant evolution in western North America: a case study in Rosaceae. *PLoS One* 7(12): e50358. Available online: <https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0050358&type=printable> [accessed 7 November 2019].
- Wehr, W.C. and D.Q. Hopkins. 1994. The Eocene orchards and gardens of Republic, Washington. *Washington Geology* 22(3):27-34.
- West, C. 2015. Green-Horse Habitat Restoration and Maintenance Project, Biological Evaluation/Biological Assessment for Botanical Species and Supplemental Botany Report. Available online: https://data.ecosystem-management.org/nepaweb/nepa_project_exp.php?project=29469 [accessed 4 November 2019].
- [WSRCD] Western Shasta Resource Conservation District. 2010. Cow Creek Strategic Fuels Reduction Plan Update. 2010. Available online: <http://www.westernshastarc.org/Docs/FireSafePlans/FirePlanswithExhibits/CowCreekFirePlan2010.pdf> [accessed 5 November 2019].

Personal Communication

Roche, Kathleen. Personal e-mail. Communication. November 4, 2019.