CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA

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Species specific matters

Maintenance of the Appendices

Periodic Review of the Appendices

Species reviews

LEWISIA SERRATA – REPORT OF THE UNITED STATES OF AMERICA

1. This document has been submitted by the United States of America.*

Introduction

2. Saw-toothed lewisia (*Lewisia serrata*) was included in Appendix II at CoP4 in 1983, and annotated to exclude seeds in 1985. The species was proposed for deletion from Appendix II by Switzerland, as the Depository Government for CITES, at COP11 in 2000. The proposal was withdrawn so that the United States could have additional time to complete a periodic review of the species which is endemic to the United States.

3. On the basis of our review, we recommend that saw-toothed lewisia be retained in Appendix II in accordance with Article II paragraph 2 (a) of the Convention and satisfying Criterion A in Annex 2a of Resolution Conf. 9.24 (Rev. CoP17).

4. In accordance with paragraph f) of Resolution Conf. 14.8 (Rev. CoP16) on the *Periodic Review of species included in Appendices I and II*, we submit the results of our review for consideration and comments from the Plants Committee.

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* *The geographical designations employed in this document do not imply the expression of any opinion whatsoever on the part of the CITES Secretariat (or the United Nations Environment Programme) concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries. The responsibility for the contents of the document rests exclusively with its author.*

1. Taxonomy

1.1 Class: Magnoliopsida

1.2 Order: Caryophyllales

1.3 Family: Portulacaceae (Montiaceae)

The species is included in the CITES Appendices under the family Portulacaceae (purslane family). This family was split into four families recently (Walters & Figueiredo 2011), and *Lewisia serrata* was transferred to the family Montiaceae (miner's lettuce family) (Nyffeler & Eggli 2010). We provide this only for informational purposes. We are not suggesting a nomenclatural change.

1.4 Genus, species or subspecies, including author and year: *Lewisia serrata* Heckard & Stebbins 1974

1.5 Scientific synonyms:

This species may be recognized by some as *L. cantelovii* J. T. Howell 1942.

The Flora of North America considers *L. serrata* to be synonymous with *L. cantelovii* (Hershkovitz & Hogan 2003), but according to the Jepson Online Interchange for California Floristics, which maintains the most current names of California plant taxa, *L. serrata* is a valid taxon that is distinct from *L. cantelovii* (Jepson Online Interchange 2018). The State of California's Department of Fish & Wildlife and the U.S. Forest Service consider these to be two distinct species and continue to manage them as such (A. Gonzales, Acting Branch Chief, Habitat Conservation Planning Branch, California Department of Fish and Wildlife, pers. comm. August 2015; Richerson 1997; Van Zuuk, K. & S. Durham. 2009).

1.6 Common names: English: Saw-toothed lewisia or sawtooth lewisia

2. Overview

Saw-toothed lewisia (*Lewisia serrata*) was listed in Appendix II at CoP4 in 1983, with an annotation to exclude seeds in 1985. It was proposed for delisting by Switzerland, as the Depository Government for CITES, at COP11 in 2000. The proposal was withdrawn so that the United States could have additional time to complete a periodic review of the species. This species is endemic to the United States(California) and continues to be rare in the wild (10-11 known occurrences). At least 2 populations have been subject to illegal collection, including one that is presumed to be extirpated, and a third population is at risk of poaching. Three sites are considered particularly accessible and so are vulnerable to horticultural collection, due to their location near roads or trails. Poaching and overharvest continue to be concerns among land managers; some populations have been subjected to drought and fire threats. The species appears to be available mostly in specialist collections, popular among rock gardeners and alpine garden plant collectors. It is not widely available in commercial nurseries. There has been no recorded trade in this species, though it is not clear that illegal trade or trade in seeds has not occurred. In addition, the California Department of Fish & Wildlife has recently seized 1,000s of succulent *Dudleya* species that were destined to be sold overseas. This may be indicative of more extensive poaching that has already or has the potential to impact saw-toothed lewisia or its habitat. Rarity has been shown to increase both the value of and demand for species. This plant is appealing among collectors who specialize in of alpine or rock gardening. One of the biggest threats to the viability of this species is poaching of the plants from the wild for horticultural use. Because this species is so rare, private or commercial collecting would threaten its existence such that the species would qualify for Appendix I. We recommend that this species be retained in Appendix II, which would be consistent with with *Annex 4 of Resolution Conf. 9.24 (Rev. CoP17)* which states that "*By virtue of the precautionary approach and in case of uncertainty regarding the status of a species or the impact of trade on the conservation of a species, the Parties shall act in the best interest of the conservation of the species concerned and, when considering proposals to amend Appendix I or II, adopt measures that are proportionate to the anticipated risks to the species.*"

3. Species characteristics

3.1 Distribution

Saw-toothed lewisia is a rare, narrowly endemic, perennial forb that is restricted to El Dorado and Placer Counties in California. The species is limited to 10 or 11 known occurrences in the American and

Rubicon River watersheds in the Sierra Nevada Mountains (Richerson 1997; Van Zuuk 2014); and as reconfirmed by the state of California (Gonzales, pers. comm. 2015), the Eldorado National Forest (B. Engelhardt, North Zone Botanist, Eldorado National Forest, USDA-Forest Service, pers. comm. September 2015), and the Tahoe National Forest (T. Quinn, Tahoe National Forest Supervisor, USDA-Forest Service, August 2015; C. Rowe, District Botanist, Tahoe National Forest, pers. comm. April 2018).

The California Department of Fish and Wildlife reports 11 known occurrences of this species, with 7 sites in the Eldorado National Forest and 4sites i the Tahoe National Forest (Gonzales, pers. comm. 2015). But the National Forest personnel track these occurrences a little differently. The Eldorado National Forest reports 5 occurrences; one locality is tracked as a single site by the Forest, while the state tracks it as three separate occurrences (Engelhardt, pers. comm. 2015). The Tahoe National Forest reports 5 occurrences (Quinn, pers. comm. 2015). The Tahoe tracks two sites separately because they are separated by more than 1/4 mile, but the State tracks those two sites as one (Rowe, pers. comm. 2018). The estimated area of occupancy of all known occurrences of this species is approximately 124 acres (CDFW 2015, attachments).

This species grows on steep-sloped, mossy outcrops and cliffs of the American and Rubicon River watersheds (USDA-FS 2001; Van Zuuk 2014), at 2,800-4,700 feet above sea level (~900-1,435 meter) (CDFW 2015, attachments; Miller & Dempster 2012). Nearly all saw-toothed lewisia occurrences are north-facing and somewhat to fully exposed to the sun (Richerson 1997; Van Zuuk 2014). Limited to the American and Rubicon river drainages, most saw-toothed lewisia plants occur in the "mist zone" of waterfalls along the inner gorges or perennial streams, with a few populations near seeps or intermittent streams (Foster 1992; USDA-FS 2001; Van Zuuk 2014). Hydrology appears to be a key determinant of suitable habitat for this species, which would be consistent with other *Lewisia* species (Davidson 2000; Engelhardt & Gross 2011; Halford & Nowak 1996).

3.2 Habitat

Saw-toothed lewisia is confined to riparian woodland, riparian forest, or seasonally wet cliffsides (Van Zuuk 2014). Riparian woodlands are open-canopied, dominated by broadleaved, deciduous trees in association with more intermittent streams. Riparian forests are distinguished as closed-canopied forests with broadleaved, deciduous trees in association with perennial or intermittent streams (USDA-FS 2001). Riparian habitats are generally dominated by broad-leaved, deciduous hardwood trees that shed their leaves in the winter (Kattelman & Embury 1996; Paulson 2018), with conifers becoming more dominant as altitude increases (Sawyer 2013).

Associated species include those associated with broadleaf upland forest and open lower-altitude montane coniferous forest (NatureServe 2017). Broadleaf species may include California buckeye, California bay laurel, canyon live oak, interior live oak, and Oregon ash (Bresette 2015; Fryer 2012; Sawyer et al. 2009; Tollefson 2008). The lower montane coniferous forest of the Sierra Nevada typically includes white fir, Douglas-fir, ponderosa pine, sugar pine, incense-cedar, and California black oak (Allen 2005; Fryer 2015).

3.3 Biological characteristics

Saw-toothed lewisia is a succulent perennial that begins as a basal rosette, taking 2-3 years from germination to reach maturity and set seed (Richerson 1997). Plants bloom from May-June and the flowers are both self-compatible and outcrossing (CalFlora 2018; Wilson 1978). Insect pollinated, the following visiting insects have been noted: *Dialactus* spp., *Protosma rubriflorus*, and *Oligodranes spp.* (Van Zuuk & Durham 2009). Offspring are produced from seed or from vegetative offsets (Richerson 1997; Rowe, pers. comm. 2018). Dispersal is mechanical. The fruits form dehiscent capsules, cracking open as they dry (mature) and shedding the seeds (Wilson 1978). Most of the leaves shrivel up as the summer progresses, but unlike some other *Lewisia* species that lose all above-ground vegetation after it blooms, this species usually keeps a few green leaves in the center of a rosette (Foster 1992).

3.4 Morphological characteristics

Saw-toothed lewisia is a succulent perennial with a thick taproot and a short stem that is topped with a cluster of leaves (Richerson 1997). Leaves are waxy and smooth and can be identified by their sawtooth edges (Foster 1992). A spray of flowers (called panicles) are borne atop 7-inch stalks (scapes); on average, there are five flowering stalks, but it ranges from 1 to 25 (Richerson 1997). Flowers are 2-6

inches (in.) across (3-8 centimeters (cm)) and petals are white petals with pale pink pinstripes (CalFlora 2018). Each flower produces a seed capsule containing 1-3 black seeds, each seed less than 1/16 inch (about 1 millimeter) in size (Miller & Dempster 2012). The length of the taproot of *Lewisia serrata* on 5 digitized herbarium specimens measured 3-9 in. (6.5-23 cm.) and showed evidence of branching into rather substantial lateral roots (Jepson Herbarium, University of California; JSTOR Global Plants Database 2018).

3.5 Role of the species in its ecosystem

Lewisia serrata provides an important stabilizing force in its steep-sloped habitat. The living root systems of gorge or cliff-dwelling species provide soil and slope stability and contribute to soil development (Ford, et al. 2016; Van Zuuk 2014). As an evergreen perennial with persistent taproots, the root and much of the above ground leaves stay in place for several years, making it more difficult for invasive species to move into that space. Thus, lewisias occupy an important functional group representative of a diverse native ecosystem that is more resistant to non-native plant invasions (Maron & Marler 2007). This species is also recognized for its aesthetic value. The Middle Fork of the American River, which runs through the Tahoe National Forest, is considered botanically "outstandingly remarkable" due to the presence of at least four occurrences of saw-toothed Lewisia there (USDA-FS 1999). In the Eldorado Forest, a botanical "Special Interest Area," which is preserved for their special features, includes parts of saw-toothed lewisia sites. The namesake for the genus (Meriwether Lewis) conveys the prominence of this plant in early 19th Century North American botanical history. Lewisias were discovered on the Lewis and Clark Expedition in 1806 and so were included among the earliest written North American flora (Davidson 2000; Miller & Dempster 2012).

4. Status and trends

4.1 Habitat trends

Riparian habitat in the Sierra Nevada experiences frequent disturbances from floods, fires, wind, herbivory, and other disturbances (Bendix & Commons 2017; Sawyer 2013). Low to moderate intensity fires are an important ecological process (Bendix & Commons 2017), but more than a century of wildfire suppression and continually increasing fuel loads has resulted in changes in fire intensity and severity in the Sierra Nevada region (Kattelmann & Embury 1996; Safford & Van de Water 2014). While native species are adapted to and will often regenerate following such disturbance, their ability to do so depends on the timing and severity of the fire (Van Zuuk 2014). Recent trends indicate that fires are increasing in number, area burned, and severity as fuel loads, temperature, and droughts continue to rise (Bendix & Commons 2017; Fried, et al. 2004; North, et al. 2016; Safford & Van de Water 2014). Higher frequency fires decrease the survival rate of trees and drive changes in species composition, pushing out fire-sensitive species or those that recover slowly after disturbances, and generally favouring dense evergreen species such as fir and incense-cedar, over hardwoods (Fried, et al. 2004; Fryer 2015; North et al. 2016).

4.2 Population size

The estimated population size of saw-toothed lewisia is between 4,212 and 5,159 individuals (Brown pers. comm. 2018; Engelhardt, pers. comm. 2015; Gonzales, pers. comm. 2015; Quinn, pers. comm. 2015). Saw-toothed lewisia is designated as a Sensitive Species by the Regional Forester in Region 5 of the U.S. Forest Service, where both the Eldorado and Tahoe National Forests are located (USDA-FS 2013; USDA-FS 2014). A Regional Forester Sensitive Species is one for which population viability is a concern either because of a downward population trend or diminished habitat capacity that would reduce its distribution (Rowe pers. comm. 2018). See 7. Legal Instruments and 8. Species Management.

Saw-toothed lewisia has the State of California Rare Plant Rank of 1B.1. This rank is reserved for plant species that are 'rare, threatened or endangered in California and elsewhere' and is 'seriously threatened' in California. Plants with this designation (California Rare Plant Rank of 1B.1) are considered by California Department of Fish and Wildlife (CDFW) to be 'endangered, rare, or threatened' under the California Environmental Quality Act (CEQA) (Gonzalez pers. comm. 2015). The condition of this species across its entire range has been ranked as G2, for imperiled species at high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors (NatureServe 2013).

4.3 Population structure

Information on population structure is scant. Further analysis is needed.

4.4 Population trends

Site visits and informal observational monitoring of the extant occurrences on the Eldorado and Tahoe National Forests indicate that the population is currently stable (Engelhardt pers. comm. 2015; Quinn pers. comm. 2015; Van Zuuk & Durham 2009). Four of the five sites on the Eldorado National Forest were burned by wildfire in 2014. A partial visit to the sites in 2015 found one plant as well as a new sub-occurrence with one plant. The fire may have decreased the number of individuals at the four sites but some individuals survived. These sites continue to be protected and monitored (Engelhardt pers. comm. 2015). Reports of illegal collection (possibly for horticultural use) at two sites may have led to the extirpation at one site and a sizable decline in the species at another (one on each Forest). The species is considered 'seriously threatened' by the California Native Plant Society and the California Department of Fish and Wildlife (Gonzalez pers. comm. 2015). See 5. Threats, 7. Legal Instruments and 8. Species Management.

5. Threats

Threats include horticultural collecting, drought, flooding, hydroelectric and infrastructure projects, and trampling by recreational users, as well as fires (Engelhardt pers. comm. 2015; Quinn pers. comm. 2015; Van Zuuk & Durham 2009).

Horticultural collecting: Heckard and Stebbins (1974, p. 307) in their description of the species noted that "propagules of plants collected at the type locality have been sold at recent annual plant sales of the California Native Plant Society. The plants are certainly too rare in nature to allow collection of garden material" (p. 307). By 1975, the species was in cultivation at the University of Berkeley Botanic Garden and the University of Washington (Wilson 1978). The species was sought after by rock gardeners and widely appreciated for its ornamental value (Hohn & Wilson 1979; Wilson 1978). Given its rare occurrence in nature, Hohn & Wilson (1979) considered that "the collection and sale of this species as garden material threaten its existence." Shortly thereafter, the United States proposed listing the species in CITES Appendix II at CoP4, with an effective date of June 1983 (Gabarone, 1983). Because of its vulnerability to poaching, saw-toothed lewisia occurrence locations are considered sensitive by the State and are not made publically available. The California Department of Fish and Wildlife is not currently aware of any wild collection for commercial use or cultivation (Gonzalez pers. comm 2015).

As noted elsewhere, legal collection of saw-toothed lewisia on the Forests would require a collection permit from the Forest. Illegal horticultural collecting has been noted as a possible reason for the loss of plants at one site and as a possible threat at another site on the Eldorado National Forest (Engelhardt pers. comm. 2015). One of those sites is reportedly extirpated and, while the cause is uncertain, it has been attributed to flooding that occurred in 1982 and 1983, drought from 1975-1977, or poaching (Van Zuuk & Durham 2009), apparently sometime between 1979 and August 1983 (Brown pers. comm. 2018). It is notable that the extirpation became evident two months after the effective date of the CITES listing. It should also be noted that there is some uncertainty about the extirpation of this site. A report in the State records from the mid-1980s recorded 350 individuals at the site in question; this has not been verified by the Forest (CDFW 2015, occurrence reports). The Forest plans to revisit this population this year to assess the situation (M. Brown, Botanist, Eldorado National Forest, USDA-FS, pers. comm. May 2018).

Illegal collection is also suspected to have occurred in the late 1990s at one site on the Tahoe National Forest (Quinn pers. comm. 2015). At this site, the estimated population size in 1990 was more than 1,000 individuals. A 1999 site visit reported that it had been poached. In 2002, 20 plants were found at that site (CDFW 2015, occurrence reports). This site was scorched by fire in 2013 (Van Zuuk 2014). There are conflicting reports as to the current number of plants at this location: one report indicates that 40-50 small plants and another reports greater than 1,000 plants (Rowe, pers. comm. 2018, occurrence report).

Illegal plant collecting has been identified as the highest risk factor for this species due to suspected poaching and illegal collection at the above two sites (USDA-FS 2001). There have been no recent reports of illegal collection on the Eldorado or Tahoe National Forests (Brown, pers. comm. 2018; Quinn pers. comm. 2015).

Drought: Drought from 1975-1977 was postulated as a possible cause for the extirpation of one site, although the exact cause cannot be determined (Van Zuuk & Durham 2009). Although riparian habitat can be more

resilient during dry periods because the water table tends to be higher near streams (Bendix & Commons 2016), studies show a positive correlation between drought and fire cycles in riparian habitat of the Sierra Nevada Mountains (Fryer 2015). This is because with regular access to water, trees in riparian areas live longer, grow more densely, and produce thicker litter and more woody debris – all of which increase fuel loads (Fryer 2015; North et al. 2016). Droughts also serve as an impetus for more water control projects.

Floods: Floods have been recorded regularly on the American River since the 1860s (Roos 2007; American River Authority 2005), and severe floods are becoming more frequent (Redmond 2008). Flood waters in the American River flow in high volume (Roos 2007) and run particularly fast through the American River watershed (ARWI 2018). Flooding may cause water to flow at such velocities that plants may be scoured from the rock face. Flooding was postulated as a possible cause for the extirpation of one site, although the exact cause remains unknown (Van Zuuk & Durham 2009). Floods may also stimulate interest in building flood control infrastructure.

Hydroelectric and infrastructure projects: There have been plans to build major dams along the American River since the 1930s (Rogers & Gahan 2013). The Folsom Dam was completed in 1955 and the Auburn Dam was authorized to be built in 1965 (American River Authority 2005; Rogers & Gahan 2013). Although both actions were underway before the discovery of saw-toothed lewisia in the area of the North and Middle Forks of the American River and the Rubicon River, it is notable that, while the Folsom Dam was well upstream from saw-toothed lewisia habitat, the Auburn Dam would be located just upstream from where the North and Middle Forks of the American River meet (American River Authority 2005; Rogers & Gahan 2013). Construction of this second dam lingered on and off for decades amidst a myriad of environmental and safety concerns weighed against concerns about flood control and water supply, until the project was officially terminated in 2008 (American River Authority 2005; Redmond 2008; Rogers & Gahan 2013). Following the severe 5-year drought of 2012-2017, considered the worst on record by the California Department of Water Resources (Kasler 2018; Kasler & Cadelago 2017), there have been renewed discussions of dam building (PBS Newshour 2015; Rothert 2018). Hydrologic alteration is considered a major threat to this species (USDA-FS 2001). Saw-toothed lewisia is found only within the confines of the American River between the North and Middle Forks and on the Rubicon River, often in the "mist zone" of waterfalls. It has long been recognized that water diversions could reduce stream flows and eliminate the mist that provides favorable habitat for this plant and so the Forest Service would conduct surveys for this plant in any area that may be affected by hydroelectric developments (Foster 1992).

Trampling by recreational users & trail maintenance: At least three of the saw-toothed lewisia sites are near roads or trails that make them accessible (CDFW 2015, attachments; Engelhardt pers. comm. 2015; Rowe pers. comm. 2018, attachments). Trails and hiking are considered a major threat to this species (USDA-FS 2001). Activities such as rock climbing or driving over the plants with off-road vehicles would injure or kill them (Van Zuuk & Durham 2009). Saw-toothed lewisia habitat is easily damaged by foot traffic. The moss-covered rock faces that provide habitat for this species are very fragile, yet the steep and cliffy terrain make the habitat difficult to fully access which likely provides some protection to the species (Engelhardt pers. comm. 2015). There have been no reports of recent damage to the accessible site on the Eldorado National Forest (Brown pers. comm. 2018). While disturbance from foot traffic was recently noted on a trail above one site on the Tahoe National Forest, there were no signs of off-trail use or damage to the plants (Rowe 2018, attachments). Trail and road maintenance may also cause damage. Initial construction of a trail uphill from one site on the Tahoe National Forest left a small area of loose boulders which might damage the plants below if disturbed by trail maintenance (Rowe 2018, attachments).

Fire: Fire may be one of the most impactful disturbances at saw-toothed lewisia sites. Since 2001, at least three major fires have burned on or near saw-toothed lewisia occurrences. The 2001 Star Fire impacted three occurrences on the Tahoe National Forest and possibly a fourth occurrence on the Eldorado National Forest (Jones 2002; USDA-Forest Service 2016b; Rowe per. comm. 2018, attachments). Large areas of the forest burned at high severity (Tempel et al. 2015). The sites were not eradicated but smaller numbers of plants were reported at three of the sites following the fire (CDFW 2015, attachments; Engelhardt pers. comm. 2015). The 2013 American Wildfire burned at low intensity on the Tahoe near one of the sites that burned in 2001, scorching but not killing the plants (Rowe per. comm. 2018, attachments; Van Zuuk 2014). The 2014 King Fire burned on the Eldorado National Forest, where four of the five known occurrences were within the perimeter of the fire and several of the sites burned at high severity (Engelhardt & Fletcher 2014; Engelhardt pers. comm. 2015). A portion of one of the burned sites was visited in 2015 and only one plant was found; it appeared to be fire- or drought-stressed. The number of individuals at the four sites may have decreased but some are expected to have survived (Engelhardt pers. comm. 2015).

Fires burning more often and more severely may drive sudden but lasting change to the forest habitat. Higher frequency fires favour conifers over hardwoods (Fried, et al. 2004; Fryer 2015; North et al. 2016). Whereas

plants in riparian habitat are generally broad-leaved hardwood, deciduous (Kattelman & Embury 1996), a conifer-dominated environment, composed of more densely growing evergreen species, would result in a more closed canopy habitat (Fried, et al. 2004; Fryer 2015; North et al. 2016). These conditions would not favour saw-toothed lewisia habitat, composed of either riparian broadleaf deciduous or more open riparian montane habitats (Richerson 1997; Van Zuuk 2014).

6. Utilization and trade

6.1 National utilization

One of the earliest mentions of this species is in a 1969 garden journal for rock garden enthusiasts (Weaver 1969). The species quickly became a favorite among rock gardeners and widely appreciated for its ornamental value (Hohn & Wilson 1979; Wilson 1978). Mathew (1994), noted that saw-toothed lewisia was growing in a few specialist collections and traded on a small scale, mostly from nursery-propagated stock. This species can be difficult to grow by the average gardener and, therefore, are often of greater interest to alpine gardeners who have the specialized knowledge needed to grow the plants (Mostul, pers. comm. 2018). The species continues to be popular among or marketed to rock gardeners (Ashwood Nurseries 2018; Rainy Side Gardeners 2007). Given its horticultural value as rock garden and alpine specimens, saw-toothed lewisia is subject to collection by rock garden enthusiasts. Easily accessible occurrences, particularly those near a trail or recreation area, are the most susceptible to illegal collection. It has long been considered that because the species is so rare, private or commercial collecting would threaten its existence (Heckard & Stebbins 1974; Wilson 1978; Richerson 1997Van Zuuk & Durham 2009). Rarity is known to increase both the demand and the value of the rare species. Hobbyist collectors are often willing to pay more money for a rare specimen (Angulo & Cuorchamp 2009; Hall et al.2008; Hinsley et al. 2015; Purcell et al. 2014). See 8.4 Artificial Propagation.

6.2 Legal trade

There has been no recorded international trade in this species and we are not aware of any current legal international trade in this species. The change in taxonomy for this species, which has been accepted by some and rejected by others, may complicate our understanding of the nature of trade and demand for this species (D. Clement, Seed Exchange Director, Alpine Garden Society, pers. comm. October 2017).

6.3 Parts and derivatives in trade

Seeds have previously been collected for cultivation. We are not currently aware of any trade in wild seeds, but note that seeds are not included in the CITES listing.

6.4 Illegal trade

We are not currently aware of illegal trade in this species; but poaching has been a historical threat to the wild populations. In addition, the California Department of Fish and Wildlife is looking into whether recent poaching incidents along coastal California has impacted saw-toothed lewisia habitat (Rowe pers. comm. 2018). See 6.5 Actual or potential trade impacts.

6.5 Actual or potential trade impacts

There has been no recorded legal trade in this species. However, several recent incidents of succulent poaching for international trade were uncovered in California. Since January 2018, California Department of Fish and Wildlife law enforcement has apprehended succulent poachers in three separate incidents in two coastal California counties (Ferreira 2018; Krieger 2018). Authorities seized more than 2,300 *Dudleya* plants that were destined to be sold in Korea, China, and Japan. The estimated market value of the plants exceeds $90,000 (Ferreira 2018).

These thefts did not impact saw-toothed lewisia or its habitat. However, the California Department of Fish and Wildlife is looking into the possibility that poaching may be more extensive and whether it has already or has the potential to impact saw-toothed lewisia habitat (pers. comm., CDFW, May 2018). Both the Eldorado and Tahoe National Forests managers are aware of these incidents and are not aware of such activities occurring in the Forests (Brown pers. comm. 2018; Rowe pers. comm. 2018).

7. Legal instruments

7.1 National

State level: The species has limited legal protection under California State law. It is not protected under either of the two primary state laws that provide protection to native plants: the Native Plant Protection Act or the California Endangered Species Act. However, the species has a California Rare Plant Rank of 1B.1 (CDFW 2015). Plants with a California Rare Plant Rank of 1B are rare throughout their range and often endemic to California. A threat rank of 0.1 indicates the plant is seriously threatened in California, with over 80% of occurrences threatened and a high degree and immediacy of threat (CNPS 2018). The known occurrences of this species are considered "sensitive" and so the location data is not made public due to the vulnerability of the species to poachers.

Plants with a California Rare Plant Rank of 1B.1 are considered to be endangered, rare, or threatened under the California Environmental Quality Act, which requires consultation to ensure that actions approved by the lead agency do not significantly impact biological resources. The CDFW typically advises that impacts to plant species with a CRPR of 1B.1 must be disclosed by the lead agency during any project review and that any significant project impacts be mitigated (Gonzales, pers. comm. 2015).

National Forest Level: All known occurrences of saw-toothed lewisia are found on Forest Service lands. As a Region 5 Forest Service Sensitive Species, under the National Environmental Policy Act, a biological evaluation is required prior to any actions that are planned, funded, executed, or permitted to determine their potential effect and minimize impacts to the sensitive species (Engelhardt pers. comm. 2015; Quinn pers. comm. 2015). Legal harvest of this plant from Forest Service lands would require that a collection permit be issued by the Forest Service. Collection permits are typically not given for Forest Sensitive species, unless for scientific or other beneficial reasons, in which case a biological evaluation would be completed to ensure that collection is limited and not likely to affect the viability of the population or species. Collection of sensitive species must also be approved by the Forest Service Supervisor (Englehardt pers. comm. 2015). The Sensitive Species designation confers certain management and conservation requirements for this species, as provided in the Forest Service Handbook and Service Manual (USDA-FS 2014). See 8.1 Management Measures

7.2 International

This species has been has been listed in CITES Appendix II since 1983, with an annotation to exclude seeds since 1985.

8. Species management

8.1 Management measures

By the Forest Service: As Regional Forester Sensitive Species (USDA-FS 2013; USDA-FS 2014), the Forest Service Manual provides policy to manage and achieve conservation goals for saw-toothed lewisia, working together with the state as it pertains to an endemic species (Engelhardt pers. comm. 2015; Quinn pers. comm. 2015). For saw-toothed lewisia, this means that the Forest Service must consider whether proposed management actions or recreational activities may affect individuals or their habitat to the extent that it will likely contribute to a loss of viability or to lead to a trend toward federal listing (USDA-FS 2001; Van Zuuk, K. 2014a). For example, following the King Fire of 2014 that burned several sites at high severity, proposed post-fire salvage efforts are near two saw-toothed lewisia sites but will be protected by large buffers. These sites continue to be protected and monitored into the future (Engelhardt pers. comm. 2015).

The Conservation Assessment for saw-toothed lewisia, written by species experts from the Eldorado and Tahoe National Forests, guides the development of management and monitoring plans for this species (Van Zuuk & Durham 2009). Accordingly, the recommended management 'prescription' for saw-toothed lewisia is to protect the species and its habitat from direct or indirect effects: 1) with regard to impacts from Forest Service Activities; 2) by acquiring and retaining any lands that have lewisia occurrences; 3) by making no visual efforts to exclude people from occurrences that are relatively easily accessible unless there is evidence of damage or poaching; 4) to protect occurrences near road/trail/utility corridors by educating maintenance workers; and 5) to maintain weed free occurrences through preventative and early manual weed treatment (Richerson 1997; Vann Zuuk & Durham 2009).

The Eldorado National Forest Land and Resource Management Plan directs the Forest Service to manage the viability of species, primarily to provide adequate protection of the species and its habitat. The Forest Service's Sierra Nevada Framework establishes standards and guidelines pertaining to the protection and consideration of sensitive plants in riparian conservation areas (Engelhardt pers. comm. 2015; Quinn, pers. comm. 2015; USDA-R5 2001, 2004). The Framework outlines management actions, five of which pertain to saw-toothed lewisia plant communities: 1) to adequately protect; 2) maintain and restore; 3) enhance and maintain the habitat; 4) preserve, restore, or enhance special aquatic features and ecological processes; and 5) identify and implement restoration actions to maintain water quality (Van Zuuk & Durham 2009). As noted elsewhere, legal collection of saw-toothed lewisia from the Forests would require a collection permit.

By the state: Saw-toothed lewisia has limited legal protection under California state law. The species is not listed as rare, threatened or endangered under the Native Plant Protection Act or the California Endangered Species Act, the two primary state laws that provide protection to native plants. This species has a California Rare Plant Rank of 1B.1. Under the California Environmental Quality Act (CEQA), plants with a California Rare Plant Rank of '1B.1' are considered by the California Department of Fish and Wildlife (CDFW) to be 'endangered, rare, or threatened.' Under CEQA, the CDFW, as the trustee for plants species in the state, has advised that lead agencies ensure that projects do not significantly impact saw-toothed lewisia or its habitat (Gonzalez pers. comm 2015).

8.2 Population monitoring

The Forest Service monitors all known occurrences of these species and provides reports to include in the state database (Gonzalez, pers. comm. 2015). Habitat is easily damaged by foot traffic, making it difficult to monitor this species without impacts to habitat and possibly threats to human safety (Engelhardt pers. comm. 2015). The terrain where some of the plants occur is very inaccessible, which also impedes population monitoring and size estimates (Quinn, pers. comm. 2015).

8.3 Control measures

8.3.1 International

There are no additional measures in place.

8.3.2 Domestic

As noted elsewhere, permits would be required to allow collection at any of the sites.

8.4 Artificial propagation

Propagules of this species were collected from the wild and sold at an annual plant sale of the California Native Plant Society the same year the species was described (Hechard & Stebbins 1974). Cultivation conditions include a well-drained, slightly acidic soil and removing old flowers when the stalks have dried (Ashwood Nurseries 2018). Heckard and Stebbins (1974, p. 307) noted that the species "does not bloom as readily" in cultivation. And according to one expert, who grew the species in the 1990s, this is mostly a "collector plant" and hybrids do not last long and "were not very interesting" (B. Mostul, Ph.D., Rare Plant Propagation, Oregon, pers. comm., April 24, 2018). Indeed, the species seems to grow well for rock gardeners who note its long bloom time (Rainy Side Gardeners 2007).

However, according to the California Native Plant Society, this species is rarely available from nurseries (CNPS 2017), and is not widely available from commercial nurseries. Saw-toothed lewisia has been included in the Royal Horticultural Society *Plant Finder* database almost continuously since 1996, which means that at least one plant nursery has offered it and suggests that the species is in cultivation in the UK or Europe (R. Wilson, Principal Data Manager, Horticultural Information and Advice, Royal Horticultural Society Garden, pers. comm. October 2017). Four commercial nurseries offer this species for sale (one each in the United States, the United Kingdom, France, and Germany), but the species is not in stock from any of them and rarely is.

The species appears to be available mostly in specialist collections. The Alpine Garden Society (United Kingdom) occasionally offers saw-toothed lewisia seeds for sale. In the past fifteen years, saw-toothed lewisia has been offered 4 times. The seeds are donated by one member. The quantities are very small, around 40 seeds total. In the United Kingdom, the plant is grown by a few "enthusiastic amateur" alpine

gardeners who probably have one or two plants (D. Clement, Seed Exchange Director, Alpine Garden Society, pers. comm. October 2017).

Ex situ collections: According to Botanic Garden Conservation International's Plant Search, the species is growing in 4 gardens (https://www.bgci.org/plant_search.php), only one of which is known for certain: The Royal Horticultural Society Garden Wisley. Material growing at the Royal Horticultural Society Garden Wisley originally came from a German seed supplier (R. Wilson, Principal Data Manager, Horticultural Information and Advice, Royal Horticultural Society Garden, pers. comm. October 2017). It is not clear how many plants are in the collection, what year they were established, and whether they sell any of their saw-toothed lewisia at their regular plant sales. In 1975, the species was in cultivation at the University of Berkeley Botanic Garden and the University of Washington (Wilson 1978). It is unknown whether these plants are extant. They may be among the other 3 gardens known to maintain this species in their collections.

8.5 Habitat conservation

As part of land and resource management, the Forests designate certain areas for special management. Special Interest Areas can be designated to recognize a broad range of values, including botanical resources. Such is the case with the Leonardi Falls Botanical Special Interest Area in the Eldorado National Forest, in which parts of two saw-toothed lewisia sites are located. The management emphasis for Special Interest Areas is to "preserve the integrity of the special features for which the areas were established" (Engelhardt pers. comm. 2015).

9. Information on similar species

None that are CITES-listed.

10. Consultations

We consulted with the State of California, where this species is endemic, and with the Eldorado and Tahoe National Forests, on which all known occurrences are found.

11. Additional remarks

As noted earlier, the family Portulacaceae was split into four families in 2010, namely Portulacaceae, Anacampserotaceae (a newly created family), Montiaceae, and Talinaceae. *Lewisia serrata* was transferred to the family Montiaceae (miner's lettuce family). We are not suggesting that this new nomenclature be adopted but wish to point out for informational purposes that, if the new family name for saw-toothed lewisia were adopted, the family name of two other CITES-listed genera would be impacted by this taxonomic transfer, namely the *Avonia* spp. and *Anacampseros* spp. are in the newly created family Anacampserotaceae (Nyffeler & Eggli 2010).

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