U.S. FISH AND WILDLIFE SERVICE

Species Report for *Ivesia webberi* (Webber's ivesia)

Nevada Fish and Wildlife Office
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EXECUTIVE SUMMARY

Ivesia webberi is a low, spreading, perennial forb with grayish-green foliage, dark red, wiry stems, and yellow flowers arranged in capitate cymes. This species is associated with an open, sparsely vegetated plant community on vernally moist, clay soils that shrink and swell upon drying and wetting. The specialized, clay soils are well developed, a process estimated to take a few thousand years, and likely cannot be recreated or restored once they are lost. Limited seed dispersal and an apparent lack of recruitment further restrict the occupied range and distribution of *I. webberi*.

Ivesia webberi has a geographic range of approximately 165 acres (ac) (66.8 hectares (ha)) comprising five counties in California and Nevada along the transition zone between the eastern edge of the northern Sierra Nevada and the northwestern edge of the Great Basin. The species is known historically from a total of 17 populations, but one has been extirpated and a portion of another (one of four subpopulations) is possibly extirpated. Of the remaining 16 populations, the status of 2 is unknown, meaning we assume the species is still present at these locations but the available information is dated or otherwise insufficient to evaluate factors affecting the species. For the remaining 14 populations where the species' status is better understood, 10 occupy less than 5 ac (2.02 ha). Reliable estimation of population sizes or trends in *I. webberi* is complicated because estimates have usually been obtained by different observers employing a variety of means and levels of survey effort. The only available estimates of abundance suggest a combined total between 990,814 and 5,029,394 individuals across the 16 extant populations. However, we have very little confidence in these estimates.

Due to the restricted range, specialized habitat requirements, and limited recruitment and dispersal of *Ivesia webberi*, populations of this species are vulnerable to ongoing and future threats that affect both individual plants and their habitat. All populations are potentially affected by a feedback loop between wildfire and nonnative, invasive plant species: 10 populations have experienced fire, and 12 populations have been invaded by nonnative, invasive plants. Eleven populations are intersected by off-highway vehicle (OHV) routes or other road corridors. Four populations on private land and two populations on public land either have already been impacted by or may be impacted by development in the near future. Two populations are currently grazed by cattle, and another seven occur within vacant grazing allotments that could be re-opened (to grazing) to alleviate pressures on other, nearby grazing allotments.

The individual and synergistic effects from nonnative, invasive species, wildfires, OHVs and roads, development, and livestock grazing have resulted in the loss and degradation of occupied habitat and continue to reduce the availability of habitat suitable for dispersal and population expansion. Given current climate change projections, we anticipate that future climatic conditions will favor further invasion by nonnative plant species and are likely to contribute to an increase in the frequency, spatial extent, and severity of wildfires. The alteration of precipitation and temperature patterns may decrease survivorship of *Ivesia webberi* by causing physiological stress, altering phenology, and reducing recruitment events and/or seedling establishment. These alterations in climatic conditions are likely to exacerbate the existing factors affecting *I. webberi* and its habitat in the future.

Seventy-two percent of habitat for *Ivesia webberi* is on Federal land (69 percent on USFS and 3 percent on BLM). The U.S Forest Service (USFS) drafted a rangewide Conservation Strategy (CS) for *I. webberi* that is intended to guide conservation actions for the species on Forest Service lands. This CS was signed in 2010, and 30 percent (13 of the 39) of the location-specific actions proposed for *I. webberi* on USFS-administered lands have been initiated. The CS will likely result in long-term benefits to *I. webberi*, although certain threats such as nonnative, invasive plant species and modified fire regime are likely to have landscape-scale impacts that will continue to present challenges to *I. webberi* conservation. There are no conservation strategies for populations on Bureau of Land Management (BLM), California Department of Fish and Wildlife (CDFW), and private lands.

BACKGROUND

Legal or Formal Status

Endangered Species Act

Ivesia webberi A. Gray (Webber's ivesia) was elevated to candidate status under the Endangered Species Act (ESA) on June 13, 2002, and has maintained this status since. Candidate species are plants and animals for which the U.S. Fish and Wildlife Service (USFWS) has sufficient information on their biological status and threats to propose them as endangered or threatened under the ESA, but for which development of a proposed listing regulation has been precluded by other higher-priority listing activities.

State of Nevada

Ivesia webberi has been declared by the Nevada Division of Forestry (NDF) to be threatened with extinction pursuant to Nevada Revised Statutes (N.R.S.) 527.260–.300 and was added to the State list of fully protected species of native flora (Nevada Administrative Code 527.010) in 2004. Removing or destroying plants on the State's fully protected list is prohibited except under special permit issued by NDF (N.R.S. 527.270).

State of California

Ivesia webberi is not listed by California under the California Endangered Species Act (CESA), but is eligible for State listing. This species has a California Native Plant Society's (CNPS) 1B.1 rank (seriously threatened in California with over 80 percent of occurrences threatened and high degree and immediacy of threat; CNPS 2013, *http://www.rareplants.cnps.org/detail/936.html*, accessed January 29, 2013). All CNPS 1B ranked plants meet the definitions under the Native Plant Protection Act (Section 1901, Chapter 10) and CESA (Sections 2062 and 2067) of the California Department of Fish and Wildlife (CDFW) Code and therefore must be fully considered during the environmental documentation process under the California Environmental Quality Act (CEQA) (Public Resources Code Section 21000 et seq.).

Bureau of Land Management

Ivesia webberi is a Bureau of Land Management (BLM) sensitive species. Populations of *I. webberi* on BLM land are managed under BLM 6840 Manual, Release 6–125, revised as of December 12, 2008 (BLM 2008, pp. 1-48). BLM policy is to manage candidate species (as designated under the ESA) as sensitive species, defined as "species that require special management or considerations to avoid potential future listing" (BLM 2008, Glossary, p. 5). The stated objective for sensitive species is to initiate proactive conservation measures that reduce or eliminate threats to minimize the likelihood of and need for listing (BLM 2008, 6840.02). Conservation, as it applies to BLM sensitive species, is defined as "the use of programs, plans, and management practices to reduce or eliminate threats affecting the status of the species, or improve the condition of the species' habitat on BLM-administered lands" (BLM 2008, Glossary, p. 2).

U.S. Forest Service

Ivesia webberi is listed on the Regional Forester's Sensitive Plant List for the Intermountain and Pacific Region of the U.S. Forest Service (USFS; Bergstrom 2009, p. 3). Populations of *I. webberi* on USFS land are managed as sensitive species under Forest Service Manual 2600, Chapter 2670 (USFS 2005, pp. 1–22). Sensitive species are defined by the USFS as species that are currently or predicted to have a downward trend in population numbers, density, or habitat that would reduce a species' existing distribution (USFS 2005, p. 12). Forest activities are required to be conducted to avoid actions that may cause a sensitive species to become threatened or endangered (USFS 2005, pp. 3–4).

Species Description

Ivesia webberi is a member of the Rosaceae (rose family). It is a low, spreading, perennial forb up to 9.8 inches (in) (25 centimeters (cm)) across with greenish-gray foliage and dark red, wiry stems (Figure 1). The 1.2–2.8 in (3–7 cm) long leaves are mostly clustered around the base of the stems, with 4–8 pairs of leaflets crowded at the tip, and are generally covered with long, silky grayish hairs. The inflorescence is a capitate or subcapitate cyme (i.e., a flat-topped inflorescence in a head-like or head shaped cluster) with 5–15 flowers per group. Flowers are about 0.4 in (10 millimeters (mm)) across and bright yellow with 5 stamens and petals that are much smaller than the sepals. The whole plant becomes reddish-tinged late in the season. Flowering typically begins in May and extends through June (Witham 2000, p. 9; Ertter 2012; *http://ucjeps.berkeley.edu/cgi-bin/get_IJM.pl?tid=29467*, accessed November 5, 2012)

FIGURE 1.—*Ivesia webberi.* S. Kulpa, USFWS

Taxonomy

Lemmon discovered *Ivesia webberi* in Sierra Valley, Plumas County, California, in 1872, and Gray (1874, p. 71) described it as a new species. Greene (1887, p. 105) included it in *Potentilla*, whereas Rydberg (1898, p. 149) treated it as *Horkelia*. Keck (1938, p. 129) resolved the taxonomy and returned this species to the genus *Ivesia*, where it has remained. The generic distinctions between *Ivesia*, *Potentilla*, and *Horkelia* have been unclear, but more recent treatments have maintained the three genera as distinct (Ertter 1989, p. 231). The various taxonomic treatments of these genera would not, however, call into question the validity of *I. webberi* as a distinct species, regardless of its generic placement (Witham 2000, p. 6). The current validity of this taxon is reviewed on the Jepson Flora Project website (Ertter 2012; *http://ucjeps.berkeley.edu/cgi-bin/get_IJM.pl?tid=29467*, accessed on November 5, 2012), which parallels the printed The Jepson Manual, Second Edition. *Ivesia webberi* is still the accepted name for this taxon native to California and Nevada.

Phenology and Life History

New leaves and flowering stems of *Ivesia webberi* appear to emerge in response to higher soil temperatures in the spring, and populations have been observed in full flower during the last week in May (Witham 2000, p. 19). Flowers open throughout the month of June, but individuals likely begin flowering in early May and some may produce flowers as late as the middle of July (Witham 2000, p. 19). The fruits, which are small, dry, and indehiscent or an achene, are likely mature in about a month, between mid-June and the end of July (Witham 2000, p. 19). While there are 5 to 15 flowers grouped as a ball on each flowering stalk, the number of achenes produced by each flower varies from 3 to 8 (Bergstrom 2009, p. 16). By late summer the plants are dried out, die back to the root caudex, and are difficult to locate (Bergstrom 2009, p. 15).

Pollinators specific to *I. webberi* have not been identified. However, Witham (2000, p. 20) notes that in general, most *Ivesia* species appear to reproduce from seed with insect-mediated pollination occurring between flowers of the same or different plants. Floral visitors have been observed frequenting the flowers of *Ivesia aperta* var. *canina*, which co-occurs with *I. webberi* at one population (USFWS 5–subpopulation Dog Valley Meadow; Johnson 2007, unpubl. photos). These floral visitors can only represent presumed pollinators because they were not observed to be carrying pollen and they represent the best available information regarding possible pollinators of *I. webberi*.

There are no studies available regarding the reproductive strategy for *Ivesia webberi*. Seeds of *Ivesia webberi* are relatively large and unlikely to be dispersed by wind or animal vectors. Upon maturation of the inflorescence and fruit, seeds are likely to fall to the ground and become lodged in crevices in the rocky, pavement-like clay soils in the immediate vicinity of parent plants (Witham 2000, p. 20). Depressions and crevices in soil frequently serve as seed accumulation or seedling establishment sites in arid ecosystems because they trap seeds and often have higher soil water due to trapped snow and accumulated precipitation (Reichman 1984, pp. 9–10; Eckert *et al.* 1986, pp. 417–420). Therefore, Witham (2000, p.20) suggests that *I. webberi* may be limited by the prevention of seed dispersal (atelochory) which may partially

explain the lack of colonization of nearby seemingly suitable, but unoccupied habitat.

Demographic monitoring has not been conducted for *Ivesia webberi*. Early surveys (1991) noted a balanced age-class structure for *I. webberi* populations (Witham 1991, pp. 4–10). However, more recent surveys (2000–2012) indicate low recruitment with populations consisting of predominantly mature plants (Witham 2000, p. 19; J. Morefield, unpubl. survey 2004; J. Morefield, unpubl. survey 2005; K. Howle and L. Henault, unpubl. survey 2009; K. Howle and N. Chardon, unpubl. survey, 2011a; K. Howle and N. Chardon, unpubl. survey, 2011b; K. Howle and N. Chardon, unpubl. survey, 2011c). The establishment and persistence of new plants could be related to annual fluctuations in precipitation, such that prolonged cycles of consistent drought throughout summer may depress new plant establishment (Bergstrom 2009, p. 16). Demographic monitoring of plants at all sites is needed to understand variation in plant establishment, growth, and reproductive potential, especially since the current trend is for populations to be dominated by mature individuals.

Habitat

Ivesia webberi occurs between 4,475 to 6,237 feet (ft) (1,364 to 1,901 meters (m)) in elevation on flats, benches, or terraces above and adjacent to large valleys (Steele and Roe 1996, unpubl. survey; Witham 2000, p.16; Howle and Henault 2009, unpubl. survey). The occupied sites vary from slightly concave to slightly convex or gently sloped (0–15°) and occur on all aspects (Witham 2000, p. 16). Sites also do not receive an accumulation of loose sediment or colluvium from upslope (Witham 2000, p. 16).

Populations of *Ivesia webberi* occur on a variety of soil series types, including, but not limited to: Reno—a fine, smectitic, mesic Abruptic Xeric Argidurid; Xman—a clayey, smectitic, mesic, shallow Xeric Haplargids; Aldi—a clayey, smectitic, frigid Lithic Ultic Argixerolls; and Barshaad—a fine, smectitic, mesic Aridic Palexeroll (USDA NRCS (U.S. Department of Agriculture Natural Resources Conservation Services) 2007, 2009a, 2009b, 2012a, 2012b). These soils are derived from andesitic, volcanic rock and the majority have an argillic (i.e., clay) horizon within 19.7 in (50 cm) of the soil surface (Witham 2000, p. 16; USDA NRCS 2007, 2009a, 2009b, 2012a, 2012b). An argillic horizon is defined as a subsurface horizon with a significantly higher percentage of clay than the overlying soil material (Soil Survey Staff 2010, p. 30). The clay content (percent by weight) of an argillic horizon must be 1.2 times the clay content of an overlying horizon (Soil Survey Staff 1999, p. 31). Agrillic horizons are illuvial, meaning they form below the soil surface, but it may be exposed at the surface later due to erosion. Typically there is little or no evidence of illuvial clay movement in soils on young landscapes; therefore, soil scientists have concluded that the formation of an argillic horizon required at least a few thousand years (Soil Survey Staff 1999, p.29). This argillic horizon represents a time-landscape relationship that can be locally and regionally important because its presence indicates that the geomorphic surface has been relatively stable for a long period of time (Soil Survey Staff 1999, p. 31).

The shallow, clay soils in which *Ivesia webberi* inhabits are very rocky on the surface and tend to be wet in the spring, but dry out as the season progresses (Zamudio 1999, p. 1). The high clay content in the soils creates a shrink-swell behavior as the soils wet and dry, which helps to

"heave" rocks in the soil profile to the surface and creates the rocky surface "pavement" (Zamudio 1999, p. 1). The unique soils and hydrology of *I. webberi* sites may exclude competition from other species (Zamudio 1999, p. 1; Witham 2000, p. 16). The shrink-swell of the clay zone, which extends into the subsoil, favors perennials with deep taproots or annuals with shallow roots that can complete their life cycle before the surface soil dries out (Zamudio 1999, p. 1; Witham 2000, pp. 16, 20). The root systems of tap-rooted perennial forbs are suited to soil with clay subsoils because the roots branch profusely under the crown, spread laterally, and penetrate the clay B horizon along vertical cleavage planes (Hugie *et al.* 1964, p. 200). The roots are flattened, but unbroken by shrink-swell activity (Hugie *et al.* 1964, p. 200). Early maturing plants, such as *I. webberi*, presumably prefer soils with these heavy clay horizons because of the abundant spring moisture, which essentially saturates the surface horizons with water.

The vernally moist, but otherwise dry and rocky habitat is typically dominated by *Ivesia webberi*, along with *Artemisia arbuscula* Nutt. (low sagebrush). On many of the sites, the vegetation could be described as an *A. arbuscula - I. webberi* association or as an *I. webberi*-perennial rock garden-type plant community. On a few sites, perennial grasses such as *Elymus elymoides* (Raf.) Swezey (squirreltail) and *Poa secunda* J. Presl (Sandburg bluegrass) play an important or even co-dominant role (Witham 1991, p. 2; 2000, p. 17 and Appendix 1, p. 5). Other associated plant species include: *Antennaria dimorpha* (Nutt.) Torr. & A. Gray (low pussytoes), which occurs at almost all occupied sites, *Balsamorhiza hookeri* (Hook.) Nutt. (Hooker's balsamroot), *Erigeron bloomeri* A. Gray (scabland fleabane), *Lewisia rediviva* Pursh (bitter root), and *Viola beckwithii* Torr. & A. Gray (Beckwith's violet) (Witham 2000, p 17; J. Morefield, unpubl. survey 2004; J. Morefield, unpubl. survey, 2005; K. Howle and L. Henault, unpubl. survey 2009; K. Howle and N. Chardon, unpubl. survey, 2011a; K. Howle and N. Chardon, unpubl. survey, 2011b; K. Howle and N. Chardon, unpubl. survey, 2011c, BLM, unpubl. survey, 2011, BLM, unpubl. survey 2012a; C. Schnurrenber, unpubl. survey, 2013).

Range and Distribution

Many of those working with *Ivesia webberi* have used the terms "site," "location," "occurrence" (often, but not always, in reference to Natural Heritage Program Element Occurrence (EO) records), "population," and "subpopulation" interchangeably. Others have aggregated smaller sites into populations according to subjective criteria which have never been explicitly defined. This generates discrepancies among sources with respect to reporting abundance and distribution of the species, with the net result being that different sources (and even different surveys by the same source) are usually not comparable. The tendency to treat each spatially discrete *I. webberi* location as a separate population can also suggest more populations than may actually exist. For the purposes of this document, the USFWS has applied spatial mapping standards devised by NatureServe and its network of Natural Heritage Programs (NatureServe 2004, entire) to aggregate 22 known, spatially discrete locations (whether extant or extirpated) of *I. webberi* into 17 spatially discrete units which we herein regard as probable "populations" of the species (Table 1). This document uses the term "subpopulation" only when necessary to reference a portion of 1 or more of these 17 populations. For further ease of reference, the USFWS has assigned a unique numerical identifier to all populations (Table 1, column 1), which is cross-referenced to corresponding Nevada Natural Heritage Program (NNHP) and California Natural

Diversity Database (CNDDB) EO numbers, where they have been assigned to known locations (Table 1, column 5). All known populations of *I. webberi* are restricted to the transition zone between the eastern edge of the northern Sierra Nevada and the northwestern edge of the Great Basin (Witham 2000, p. 15). *Ivesia webberi* occupies approximately 165 ac (66.8 ha) of lands managed by the USFS (69 percent), BLM (3 percent), CDFW (12 percent), and private owners (16 percent). As discussed below, 1 of these 17 populations is presumed extirpated; the 16 remaining (extant) populations are depicted in Figure 2.

Until 1990–1991, nearly all the California populations and many of the Nevada populations of *Ivesia webberi* were known only from historic herbarium collections. Field surveys sponsored in 1990 and 1991 by the Plumas, Tahoe, and Humboldt-Toiyabe National Forests succeeded in relocating a few of these historical populations (USFWS 1, 5–subpopulation Dog Valley Meadow, and 13) and documenting new populations around the California-Nevada border (USFWS 6 and 7) (Duron 1990, entire; Witham 1991, entire). Subsequent, expanded survey efforts in 1997–1998 rediscovered all known populations (USFWS 1, 2, 3, 4, 5–subpopulation Dog Valley Meadow, 6, 7, 8, 13, 14, and 16) and documented one additional population in Nevada (USFWS 12) (Witham 2000, entire). Between 2006 and 2013, four new populations (USFWS 9, 10, 11, and 15) and two new subpopulations (USFWS 5–subpopulation Upper Dog Valley and USFWS 9–subpopulation Stateline Road 1b) were documented, all within 3 mi (4.8 km) of previously existing populations, with the exception of USFWS 11 (J. Picciani, unpubl. survey 2006; K. Howle and L. Henault, unpubl. survey 2009; J. Morefield, unpubl. survey 2010a; K. Howle and N. Chardon, unpubl. survey, 2011a; K. Howle and N. Chardon, unpubl. survey, 2011b; K. Howle and N. Chardon, unpubl. survey, 2011c; C. Schnurrenber, unpubl. survey, 2013). Population USFWS 11 is approximately 8 mi (12.9 km) from the closest populations (USFWS 12 and 13; Figure 2).

Several *Ivesia webberi* locations reported in early literature either have no corresponding herbarium specimens, or there is insufficient information on the label to determine the location (either approximate or precise) from which the original specimen was collected (Witham 2000, p. 11). Still other historical records appear to be erroneous and warrant mention here. Two records in the CNDDB (2012) are suspected to be erroneous—Webber Lake and Indian Valley, both in California. Witham (2000, p. 14) explains that although these two locations were noted by Gray (1874, p. 71), Lemmon (1908, p. 20) identified Dr. Webber's Sierra Valley property as the *I. webberi* location (where, as with Webber Lake, Dr. Webber also owned property). Subsequent work by Keck (1938, p. 130) supports Lemmon's locality interpretation, in that Keck was unable to find any collections in the Gray herbarium labeled Indian Valley or otherwise attributed to Dr. Webber. Lastly, Witham (2000, p. 14) surveyed the vicinity of Webber Lake, but found no suitable habitat for the species. In Nevada, *I. webberi* identified as from the Pyramid Lake area is also likely to have been labeled erroneously. Herbarium labels from 1959 specify a desert area and very sandy hillside with an elevation around 4,000 ft (1,219 m; University of Nevada, Reno (UNR) herbarium 2012; *http://contentdm.library.unr.edu/cdm4/search.php?CISOROOT=/herb*, accessed on November 6, 2012). Witham (2000, p. 14) surveyed for potential suitable habitat in this location and found none; additionally, the described habitat of "desert area" and "very sandy hillside" is completely unlike any of the known habitat of *I. webberi* in California and Nevada.

There is one credible historical record indicating that *Ivesia webberi* occurred in the American Valley in California (California Department of Fish and Wildlife (CDFW) 2012, p. 2). Within the American Valley, historical locations for *I. webberi* now support the town of Quincy, thus it is presumed extirpated from this location (Duron 1990, pp. 12–13; this is population USFWS 17 in Table 1). In Nevada, vague herbarium records report *I. webberi* in the vicinity of Hunter and Alum Creeks (UNR herbarium 2012; *http://contentdm.library.unr.edu/cdm4/search.php?CISOROOT=/herb*, accessed on November 6, 2012). Although most terraces in these areas are now either covered in houses or residential landscaping (Witham 1991, p. 10; Witham 2000, p. 13), there are two extant populations (USFWS 15 or 16, Table 1) in the vicinity of these creeks; on this basis, and for purposes of this status assessment, we have not assumed the species to have been extirpated from these areas. Therefore, no Nevada populations are known or presumed extirpated.

Additional surveys of potential habitat in American, Indian, and Genesee Valleys in Plumas County, California, in the vicinity of known occurrences in western Washoe County, Nevada (2,055 ac (539 ha) surveyed), and in the Pine Nut Mountains, Douglas and Washoe Counties, Nevada (1,900 ac (579 ha) surveyed) documented no additional populations of the species (Duron 1990, pp. 13–14; Witham 2000, p. 13, Appendix 1, pp. 3–4). It is possible that additional *Ivesia webberi* sites may be found outside of these areas, however, field observations indicate that a site that looks suitable from a distance usually ends up being too dry or lacks the shallow clay soils associated with the species (Witham 2000, p. 14). In California, the western rim of Upper Long Valley in Sierra County is the only area that may support high quality potential habitat that has not been surveyed, but this area is primarily private property and is unlikely to be surveyed (Witham 2000, p. 19).

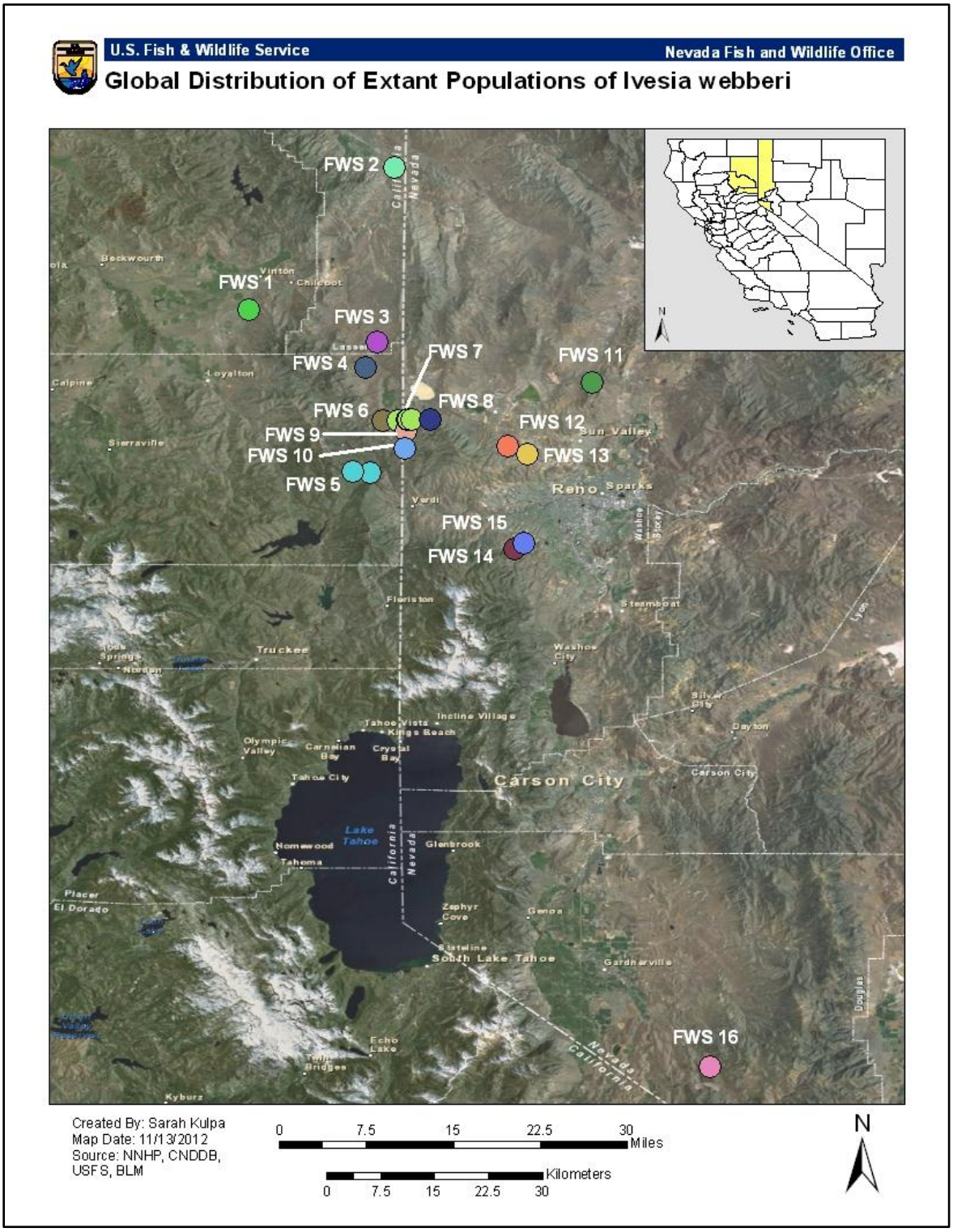

FIGURE 2.—Global distribution of extant populations of *Ivesia webberi*. Circles represent the geographic center of extant, mapped occurrences. Circles in close proximity to each other that are depicted in the same color represent occurrences that were grouped together by the USFWS as populations, according to NatureServe mapping standards (NatureServe 2004, entire).

TABLE 1.—Summary of *Ivesia webberi* populations in Nevada and California.

Population (USFWS)	Site Name	State	County	EO *	EO Rank **	# of Surveys	Population estimate range(s)	Estimated area (ac/ha)	Land Owner	Threats ***
1	Sierra Valley	CA	Plumas	CA 1	B	3	50–10,000	44.80 (18.12)	BLM Private State	f g n o
2	Constantia	CA	Lassen	CA 11	E	1	100–999	1.91 (0.77)	BLM	f
3	East of HJWA, Evans Canyon	CA	Lassen	CA 10	D	3	115–130	0.14 (0.06)	BLM	f
4	Hallelujah Junction WA	CA	Sierra	CA 8	D	3	300–400	0.05 (0.02)	State	f
5	Dog Valley Meadow	CA	Sierra	CA 4	A	1	100,000	71.58 (28.97)	USFS	f n o
	Upper Dog Valley	CA	Sierra		BC	1	5,000	0.99 (0.40)	USFS	f n o
6	White Lake Overlook	CA	Sierra	CA 7	E	1	10,000	13.56 (5.49)	USFS	f
7	Mules Ear Flat	CA	Sierra	CA 6	D	1	<100	0.14 (0.06)	USFS	f n o
	Three Pine Flat	NV	Washoe	NV 2	C	1	1,000	1.13 (0.46)	Private	f n o
	Halfway Slope	NV	Washoe	NV 4	H	1	1,000	0.31 (0.13)	Private	d f n o
	Jeffrey Pine Saddle	NV	Washoe	NV 3	C	1	1,000	0.42 (0.17)	Private	f n o
8	Ivesia Flat	NV	Washoe	NV 8	BC	1	100,000	0.73 (0.30)	USFS	f n o
9	Stateline Road 1a	NV	Washoe		C	1	1,000	7.03 (2.84)	USFS	d f n
	Stateline Road 1b	NV	Washoe		D	1	50	0.01 (0.004)	USFS	d f o
10	Stateline Road 2	NV	Washoe		C	1	2,000	4.03 (1.63)	USFS	d f n
11	Hungry Valley	NV	Washoe		D	1	2,120	0.16 (0.06)	BLM	f g n o
12	Black Springs	NV	Washoe	NV 5	C	2	>500 to 1,000	6.31 (2.55)	USFS	f n o
13	Raleigh Heights	NV	Washoe	NV 7	B	5	<100,000–4,000,000	9.55 (3.86)	USFS	f n o
14	Dutch Louie Flat	NV	Washoe	NV 9	AC	4	600,000–693,795	1.35 (0.55)	Private	d f n o
15	The Pines Powerline	NV	Washoe	NV 15	AC	2	63,300	0.14 (0.06)	Private	d f n o
16	Dante Mine Road	NV	Douglas	NV 1	C	7	3,179–36,500	0.56 (0.23)	BLM Private	d f n o

17	American Valley	CA	Plumas	CA 2	X	historical collection from 1886, area searched in 1990 and no plants seen, suitable habitat eliminated, presumed extirpated

Table 1.—Footnotes:
*EO = Element occurrences mapped in the NNHP (NV) or CNDDB (CA) databases. Populations without numbers indicate unlogged in the NNHP or CNDDB databases.
**EO rank = Element occurrence ranks established by the NNHP or CNDDB based on NatureServe protocol (NatureServe Explorer; *http://www.natureserve.org/explorer/*, accessed December 11, 2012). Letters reflect an assessment of estimated viability (species) or ecological integrity; refer to the text for the corresponding rank definitions.
***Threats = **d:** private/municipal development, **f:** wildfire and suppression activities, **g:** animal grazing/trampling, **n:** nonnative, invasive plant species, and **o:** OHV use and/or road corridors

Abundance and Population Trend

Reliable estimation of population sizes or trends in *Ivesia webberi* is complicated by multiple factors. Estimates of population size (in terms of the abundance of individuals) have usually been obtained by different observers employing a variety of means and levels of survey effort. At one extreme, observations consist of coarse estimates (e.g., individuals ranging from 0 to 100, 100 to 999, > 1,000, etc.); at the other extreme, they consist of meticulous counts of every plant present. Still other observers have estimated abundance by extrapolating from counts within a small portion of occupied habitat (delimited with or without the use of plots and/or transects, usually without random placement of these sampling units). To be reliable, surveys (whether for purposes of estimating size or detecting trends) for *Ivesia webberi* must occur during the narrow spring window when plants are flowering, because by late summer plants dry out and die back to the root caudex, and are difficult to detect (Bergstrom 2009, p. 15). Surveys outside of this window are therefore likely to underestimate the number of individuals present. Finally, differences in the methods used to map populations create additional discrepancies, in that boundaries vary considerably in terms of the unoccupied (but presumed suitable) and/or buffer habitat included. Protocols used to map the California populations are apt to result in a substantial overestimate of the actual occupied area (Witham 2000, p. 12).

The combined total of available estimates of individual plants at the 16 extant populations ranges between 990,814 and 5,029,394 individuals. We have very little confidence in these estimates of abundance; we present them solely because they represent the only available estimates for *Ivesia webberi*. Eight of the 16 extant populations have a single population estimate; therefore, population trends at these 8 locations cannot be determined (Table 1). Of the remaining eight populations, two are characterized by two estimates of abundance; and one of these two populations appears to be stable when estimates are compared. Although three or more surveys have occurred at the remaining populations, survey data and methods are too variable to infer trends.

Current Status of Populations and Habitat

In this section, we summarize information on the status of *Ivesia webberi* populations (i.e., surveys, population estimates, threats). We also use a method developed by NatureServe for categorically ranking each population and/or subpopulation in terms of its relative quality (i.e.,

abundance, age class distribution, abiotic and biotic conditions, landscape context). We first present rank criteria as specifically developed for *Ivesia webberi* by NatureServe, followed with site information including the ranks assigned to each location.

NatureServe Element Occurrence Ranking Criteria

NatureServe and its network of Natural Heritage Programs use the generic approach for ranking EOs to provide a succinct assessment of the estimated viability (probability of persistence) of mapped occurrences of any given tracked entity (Hammerson *et al.* 2008, entire). These ranks provide an estimation of the likelihood, that if current conditions prevail, a species occurrence will persist for a period of time. Because EO ranks are used to represent the overall "quality" of an occurrence as it currently exists, they are based solely on criteria that represent the present status of the occurrence such as size (abundance), occupied area, abiotic and biotic conditions, and landscape context. Future threats are not used to "downgrade" an occurrence rank, but ongoing events that result in inexorable degradation of occurrence quality are considered. While the generic approach to ranking EOs is used for most species, specific criteria for assigning ranks A through D have been developed for particular species, such as *Ivesia webberi*, (NatureServe Explorer; *http://www.natureserve.org/explorer/*, accessed December 11, 2012), and are presented below.

> **Excellent Viability (A):** SIZE: At least 4,000 maximum detectable individuals occupying at least 9.89 ac (4 ha) of apparently suitable habitat. CONDITION: Multiple age classes present in ratios appropriate to generation time of population. Evidence of flowering and fruiting, seedlings, or other indications that reproductive mechanisms are intact. Less than 5 percent cover of exotic plant species. Less than 5 percent cover of significant anthropogenic impacts. LANDSCAPE CONTEXT: Surrounding area is relatively unfragmented and includes ecological processes needed to sustain the population and its habitat.
>
> **Good Viability (B):** SIZE: At least 1,000 maximum detectable individuals occupying at least 2.47 ac (1 ha) of apparently suitable habitat. CONDITION: Multiple age classes present in ratios appropriate to generation time of population. Evidence of flowering and fruiting, seedlings, or other indications that reproductive mechanisms are intact. Less than 10 percent cover of exotic plant species. Less than 10 percent cover of significant anthropogenic impacts. LANDSCAPE CONTEXT: Surrounding area includes the ecological processes needed to sustain the population and its habitat, though it may be significantly fragmented, invaded by exotics, or otherwise impacted by humans.
>
> **Fair Viability (C):** SIZE: At least 200 maximum detectable individuals occupying at least 0.49 ac (0.2 ha) of apparently suitable habitat. CONDITION: Multiple age classes present, but often in ratios indicating reduced or irregular recruitment. Evidence of flowering and fruiting, seedlings, or other indications that reproductive mechanisms are intact. Up to 50 percent cover of exotic plant species and/or up to 50 percent cover of significant anthropogenic impacts. LANDSCAPE CONTEXT: Surrounding area may be heavily fragmented, disturbed, and/or invaded by exotics, but still includes the ecological processes needed to sustain the population and its habitat.

Poor Viability (D): SIZE: less than 200 maximum detectable individuals occupying and/or less that 0.49 ac (0.2 ha) of apparently suitable habitat occupied. CONDITION: Little or no evidence of successful or sustainable reproduction (poor age class distribution, no seedlings, and/or no evidence of flowering, fruiting, etc.). Cover of exotic plant species and/or significant anthropogenic impacts may exceed 50 percent. LANDSCAPE CONTEXT: Surrounding area may be heavily fragmented, disturbed, and/or invaded by exotics, with some of the ecological processes needed to sustain the population and its habitat no longer intact.

In addition to these species-specific criteria for *Ivesia webberi*, the following generic EO ranks have been established by NatureServe (Hammerson *et al*. 2008) and applied in our assessment of this species:

Verified Extant (E): Occurrence recently has been verified as still existing, but sufficient information on the factors used to estimate viability of the occurrence has not yet been obtained. The E rank is used when the occurrence is thought to be extant, but an A, B, C, D, or combination rank cannot be assigned.

Failed to Find (F): Occurrence has not been found despite a search by an experienced observer at a time and under conditions appropriate for the occurrence at a location where it was previously reported, but the occurrence still might be confirmed to exist at the location with additional field survey efforts.

Historical (H): Recent field information verifying the continued existence of the occurrence is lacking. Examples of this rank include occurrences based only on historical collection data, or occurrences that previously were ranked A, B, C, D, or E, but that are now, without field survey work, considered to be possibly extirpated due to general loss or degradation of the environment in the area (i.e., there has been a known major disturbance since the last observation such that the continued existence of the occurrence is in doubt).

Extirpated (X): Adequate surveys by one or more experience observers at times and under conditions appropriate for the species at the occurrence location, or other persuasive evidence, indicate that the species no longer exists there or that the habitat or environment of the occurrence has been destroyed to such an extent that it can no longer support the species.

Site Accounts

USFWS 1 – Sierra Valley

USFWS 1 is the type locality for *Ivesia webberi*. Property owners within this site include the BLM, State of California, and private. Mapping efforts indicate that the population encompasses 44.8 ac (18.1 ha) or 27.17 percent of the total amount of occupied habitat mapped for *I. webberi*. However, as noted (above in *Abundance and Population Trend*), protocols used to map this and other California populations have been characterized as substantial overestimates of actual

occupied area (Witham 2000, p. 12); thus, this population likely occupies a much smaller area. The population has been surveyed three times (1990, 1992, and 1998). The 1990 survey estimated 2,000 individuals (C. Witham and G. Kareofelas, unpubl. survey, 1990), the 1992 survey was only on BLM land and estimated 50 individuals (G. Schoolcraft, unpubl. survey, 1992), and the 1998 survey estimated 10,000 individuals total on private and State lands (G. Schoolcraft, unpubl. survey, 1998). Note that, the 1998 survey was conducted in August when plants are typically dried out and difficult to locate. The north and east edges of the population are invaded by the nonnative, invasive, annual grass *Bromus tectorum* L. (cheatgrass) and have been heavily grazed by domestic sheep and cattle. An off-highway vehicle (OHV) trail also transects the population (Duron 1990, p. 9; Witham 1991, p. 9; G. Schoolcraft, unpubl. survey, 1992; G. Schoolcraft, unpubl. survey, 1998). Although this population may meet the criteria for an EO rank of "A" in terms of number of individuals and acreage, anthropogenic factors (OHVs, grazing, and nonnative, invasive plants) have prompted us to assign a rank of "B" to this population.

USFWS 2 – Constantia
USFWS 2 occurs on BLM land. This population occupies 1.91 ac (0.77 ha) or 1.16 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This population was surveyed once in 1996 and estimated to contain 100–999 individuals. Nothing is known about the condition of the habitat at this site (H. Steele and L. Roe, unpubl. survey 1996). Based upon this information and the above EO rank criteria, we assigned a rank of "E" to this population.

USFWS 3 – East of Hallelujah Junction Wildlife Area, Evans Canyon
USFWS 3 occurs on BLM land. Unlike other *Ivesia webberi* populations, this population's co-dominant species is *Artemisia tridentata* Nutt. (big sagebrush) and not *Artemisia arbuscula* (C. Krumm and G. Clifton, unpubl. survey 1996). This population occupies 0.14 ac (0.06 ha) or 0.08 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. A 1996 survey estimated that 100–999 *I. webberi* individuals were present (C. Krumm and G. Clifton, unpubl. survey 1996). In July 2007 a wildfire burned through this population; a 2008 survey could not locate any individuals (Sustain Environmental Inc. 2009, p. III-19). However, a 2013 survey relocated this population and estimated that 115–130 *I. webberi* individuals were present (S. Kulpa and J. Johnson, unpubl. survey 2013a). Based upon this information and the above EO rank criteria, we assigned a rank of "D" to this population.

USFWS 4 – Hallelujah Junction Wildlife Area
USFWS 4 occurs on State land owned by the CDFW. This population occupies 0.05 ac (0.02 ha) or 0.03 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. A 1992 survey estimated that 200 *I. webberi* individuals were present (C. Witham, unpubl. survey 1992). In July 2007 a wildfire burned through this population; a 2008 survey could not locate any individuals (Sustain Environmental Inc. 2009, p. III-19). However, a 2013 survey relocated this population and estimated that 300–400 *I. webberi* individuals were present (S. Kulpa and J. Johnson, unpubl. survey 2013b). Based upon this information and the above EO rank criteria, we assigned a rank of "D" to this population.

USFWS 5 – Dog Valley Meadow and Upper Dog Valley
USFWS 5–subpopulation Dog Valley Meadow occurs on USFS land. This subpopulation is

located within drier portions of Dog Valley Meadow (Bergstrom 2009, p. 10). Mapping efforts indicate that the subpopulation encompasses 71.78 ac (29.05 ha) or 43.41 percent of the total amount of occupied habitat mapped for *I. webberi*. However, as noted (above in *Abundance and Population Trend*), protocols used to map this and other California subpopulations have been characterized as substantial overestimates of actual occupied area (Witham 2000, p. 12), thus this subpopulation likely occupies a much smaller area within Dog Valley Meadow. This subpopulation was surveyed in 1991 and estimated to contain 100,000 individuals (C. Witham and G. Kareofelas, unpubl. survey 1991a). This subpopulation was historically grazed, but the USFS grazing allotment is currently vacant. It also receives high recreational use due to its proximity to Reno and Verdi, Nevada, and OHV use has been observed in the meadow (Bergstrom 2009, pp. 10, 25). Additionally, *Poa bulbosa* L. (bulbous bluegrass), a nonnative, invasive grass, has expanded into the periphery of the subpopulation from nearby, abandoned irrigation ditches (Bergstrom 2009, p. 24). Based upon this information and the above EO rank criteria, we assigned a rank of "A" to this subpopulation.

USFWS 5–subpopulation Upper Dog Valley occurs on USFS land. This subpopulation occupies a gentle toe-slope on the eastern side of the valley. This subpopulation occupies 0.99 ac (0.4 ha) or 0.6 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This subpopulation was discovered in 2009 and estimated to contain 5,000 individuals (K. Howle and L. Henault, unpubl. survey 2009). This subpopulation was historically grazed, but the USFS grazing allotment is currently vacant (Bergstrom 2009, p. 27). OHV activities have occurred across a portion of the population as evidenced by wheel ruts (Bergstrom 2009, p. 10). *Bromus tectorum* is also present within this subpopulation. Based upon this information and the above EO rank criteria, we assigned a rank of "BC" to this subpopulation.

USFWS 6 – White Lake Overlook

USFWS 6 occurs on USFS land. Mapping efforts indicate that the population encompasses 13.56 ac (5.49 ha) or 8.22 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. However, as noted (above in *Abundance and Population Trend*), protocols used to map this and other California populations have been characterized as substantial overestimates of actual occupied area (Witham 2000, p. 12), thus this population likely occupies a much smaller area. This population was surveyed in 1991 and estimated to contain 10,000 individuals (C. Witham and G. Kareofelas, unpubl. survey, 1991b). This population was historically grazed, but the grazing allotment is currently vacant (Bergstrom 2009, p. 27). Although described as relatively undisturbed in the survey report, this site has not been surveyed since; therefore the current condition of the habitat is unknown (C. Witham and G. Kareofelas, unpubl. survey, 1991b). Based upon this information and the above EO rank criteria, we assigned a rank of "E" to this population.

USFWS 7 – Mules Ear Flat, Three Pines Flat, Halfway Slope, and Jeffrey Pine Saddle

USFWS 7–subpopulation Mules Ear Flat occurs on USFS land. This subpopulation occupies 0.14 ac (0.06 ha) or 0.08 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This subpopulation was surveyed in 1991 and estimated to contain less than 100 individuals (C. Witham and G. Kareofelas, unpubl. survey 1991c). This subpopulation was historically grazed, but the USFS grazing allotment is currently vacant (Bergstrom 2009, p. 27). A 1984 wildfire burned through this subpopulation (BLM, Geospatial Data 2012b). OHV

damage has been observed within the subpopulation and several dirt roads are within its vicinity. *Bromus tectorum* is invading the margins of this subpopulation (Bergstrom 2009, p. 12). Based upon this information and the above EO rank criteria, we assigned a rank of "D" to this subpopulation.

USFWS 7–subpopulation Three Pines Flat is on private land within the Humboldt-Toiyabe National Forest boundary. This subpopulation occupies 1.13 ac (0.46 ha) or 0.69 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This subpopulation was surveyed in 1991 and estimated to contain 1,000 individuals (C. Witham and G. Kareofelas, unpubl. survey 1991d). This subpopulation was historically grazed, but the USFS grazing allotment is currently vacant (Bergstrom 2009, p. 27). A 1984 wildfire burned through this subpopulation (BLM, Geospatial Data 2012b). OHV damage has been observed within the subpopulation and several dirt roads are within its vicinity. Nonnative, invasive plant species are also present within this subpopulation (C. Witham and G. Kareofelas, unpubl. survey 1991d). Based upon this information and the above EO rank criteria, we assigned a rank of "C" to this subpopulation.

USFWS 7–subpopulation Halfway Slope is on private land within the Humboldt-Toiyabe National Forest boundary. This subpopulation occupies 0.31 ac (0.13 ha) or 0.19 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This subpopulation was surveyed in 1991 and estimated to contain 1,000 individuals (C. Witham and G. Kareofelas, unpubl. survey 1991e). This subpopulation was historically grazed, but the USFS grazing allotment is currently vacant (Bergstrom 2009, p. 27). A 1984 wildfire burned through this subpopulation (BLM, Geospatial Data 2012b). At the time of the 1991 survey, OHV damage and nonnative, invasive plants were observed within the subpopulation and several dirt roads were within its vicinity. In 2004, a private residence and road were constructed within its boundaries, likely extirpating this subpopulation (observed using ESRI ArcGIS Imagery Basemap satellite imagery; C. Witham and G. Kareofelas, unpubl. survey 1991e). Given the extent of habitat alteration that has occurred since the species was last observed at this location, we assigned a rank of "H" to this subpopulation.

USFWS 7–subpopulation Jeffrey Pine Saddle is on private land within the Humboldt-Toiyabe National Forest boundary. This subpopulation occupies 0.42 ac (0.17 ha) or 0.25 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This subpopulation was surveyed in 1991 and estimated to contain 1,000 individuals (C. Witham and G. Kareofelas, unpubl. survey 1991f). This subpopulation was historically grazed, but the USFS grazing allotment is currently vacant (Bergstrom 2009, p. 27). A 1984 wildfire burned through this population (BLM, Geospatial Data 2012b). OHV damage has been observed within the subpopulation and several dirt roads are within its vicinity. Nonnative, invasive plants are also present within this subpopulation (C. Witham and G. Kareofelas, unpubl. survey 1991f). Based upon this information and the above EO rank criteria, we assigned a rank of "C" to this subpopulation.

USFWS 8 – Ivesia Flat

USFWS 8 occurs on USFS land. This population occupies 0.73 ac (0.3 ha) or 0.44 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This population was surveyed in 1997 and estimated to contain 100,000 individuals (C.Witham, unpubl. survey 1997a). This population was historically grazed, but the USFS grazing allotment is currently vacant

(Bergstrom 2009, p. 27). This population is situated between two USFS roads with evidence of an overgrown user-created OHV trail traversing the population. *Bromus tectorum* is also present within this population (Bergstrom 2009, p. 8). Based upon this information and the above EO rank criteria, we assigned a rank of "BC" to this population.

USFWS 9 – Stateline Road 1a and 1b

USFWS 9–subpopulation Stateline Road 1a occurs on USFS land. This subpopulation occupies 7.03 ac (2.84 ha) or 4.26 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This subpopulation was discovered in 2011 during surveys along the proposed Bordertown to California Transmission Line preferred Stateline Route (USFS 2012a, entire). It is estimated to contain 1,000 individuals. This subpopulation was historically grazed, but the USFS grazing allotment is currently vacant (Bergstrom 2009, p. 27). *Taeniatherum caput-medusae* (L.) Nevski (medusahead), a nonnative, annual grass, is invading this subpopulation (K. Howle and N. Chardon, unpubl. survey, 2011a; K. Howle and N. Chardon, unpubl. survey, 2011b). Although this subpopulation may meet the criteria for a rank of "B" in terms of number of individuals and acreage, the extent of the infestation from *Taeniatherum caput-medausae* prompts us to assign a rank of "C" to this population.

USFWS 9–subpopulation Stateline Road 1b occurs on USFS land. This subpopulation occupies 0.01 ac (0.004 ha) or 0.01 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This subpopulation was discovered in 2013 during surveys along the proposed Bordertown to California Transmission Line (C. Schnurrenberger, unpubl. survey 2013). It is estimated to contain 50 individuals. This subpopulation was historically grazed, but the USFS grazing allotment is currently vacant (Bergstrom 2009, p. 27). This subpopulation is situated along an old roadbed that is now blocked off and does not appear to experience much foot traffic, however could experience disturbance from road maintenance. Very few nonnative, invasive plant species are in this area (C. Schnurrenberger, unpubl. survey 2013). Based upon this information and the above EO rank criteria, we assigned a rank of "D" to this population.

USFWS 10 – Stateline Road 2

USFWS 10 occurs on USFS land. This population occupies 4.03 ac (1.63 ha) or 2.44 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This population was discovered in 2011 during surveys along the proposed Bordertown to California Transmission Line preferred Stateline Route (USFS 2012a, entire). It is estimated to contain 2,000 individuals. This population was historically grazed, but the USFS grazing allotment is currently vacant (Bergstrom 2009, p. 27). *Taeniatherum caput-medusae* is invading this population (K. Howle and N. Chardon, unpubl. survey, 2011c). Although this population may meet the criteria for a rank of "B" in terms of number of individuals and acreage, the extent of the infestation from *Taeniatherum caput-medausae* prompts us to assign a rank of "C" to this population.

USFWS 11 – Hungry Valley

USFWS 11 occurs on BLM land. This population occupies 0.16 ac (0.06 ha) or 0.1 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This population was discovered in 2010 and estimated to contain 2,120 individuals (J. Morefield, unpubl. survey 2010a). In 1999, a wildfire burned through this population (BLM, Geospatial Data 2012b). A high-density residential development is within a few miles of the population, thus it is used for recreation as

evidenced by OHV tracks and dirt roads bisecting the population. Additionally, the population is grazed by cattle and *Bromus tectorum* is present (J. Morefield, unpubl. survey 2010a; S. Kulpa, unpubl. data 2012). Based upon this information and the above EO rank criteria, we assigned a rank of "D" to this population.

USFWS 12 – Black Springs

USFWS 12 occurs on USFS lands. This population occupies 6.31 ac (2.55 ha) or 3.83 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. The population has been surveyed twice (2000 and 2004). The 2000 survey estimated less than 500 individuals (K. Zamudio, unpubl. survey, 2000a) and the 2004 survey estimated 1,000 individuals (J. Baggs and J. Fraser, unpubl. survey 2004). However, the 2000 survey was conducted in September when plants are typically dried out and difficult to locate. This population was historically grazed, but the USFS grazing allotment is currently vacant (Bergstrom 2009, p. 27). A dirt road from a subdivision adjacent to the USFS boundary runs parallel to the site and intersects a crossroad at the upper boundary of the population (Bergstrom 2009, p. 9). Additionally, USFS Route #41465 bisects the population (USFS 2012b; *http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5305083.pdf*, accessed on November 20, 2012). *Bromus tectorum* is also present within and adjacent to the population (J. Baggs and J. Fraser, unpubl. survey 2004). Based upon this information and the above EO rank criteria, we assigned a rank of "C" to this population.

USFWS 13 – Raleigh Heights

USFWS 13 occurs on USFS lands. This population occupies 9.55 ac (3.86 ha) or 5.79 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This population was surveyed five times—1991 (C. Witham and G. Kareofelas, unpubl. survey 1991g), 1997 (C. Witham, unpubl. survey 1997b), 1999 (K. Zamudio, unpubl. survey 1999b), 2000 (K. Zamudio, unpubl. survey 2000b), and 2002 (J. Baggs, J. Fraser, and K. Crowell, unpubl. survey 2002a), but population estimates were only provided during two of the five surveys (1991 and 1997). Population estimates varied greatly, from 100,000 individuals in 1991 to 4,000,000 individuals in 1997, further illustrating complications in inferring population trends from these survey data. This population's proximity to the urban interface with high recreational use, as well as the periodicity of fire within the Peavine area is of concern (Bergstrom 2009, p. 8). User-created OHV trails and USFS Routes #21549 and #21550 bisect the population (USFS 2012b; *http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5305083.pdf*, accessed on November 20, 2012). *Bromus tectorum* and *Taeniatherum caput-medusae* are located adjacent to and within this population (J. Baggs, J. Fraser, and K. Crowell, unpubl. survey 2002a; USFS, Geospatial Data 2010). Although this population may meet the criterion for a rank of "A" in terms of number of individuals and approaches the criterion for acreage, the extent of degradation from OHV impacts and nonnative, invasive plant species prompts us to assign a rank of "B" to this population.

USFWS 14 – Dutch Louie Flat

USFWS 14 occurs on private lands. This population occupies 1.35 ac (0.55 ha) or 0.82 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This population was surveyed three times (1997, 2002, and 2006). The 1997 survey estimated 600,000 individuals (C. Witham, unpubl. survey 1997c), the 2002 survey did not provide an estimate of individuals

(J. Baggs, J. Fraser, and K. Crowell, unpubl. survey 2002b), and the 2006 survey estimated 693,795 individuals (Wood Rogers 2007, Tables 2 and 3, pp. 5–6). This population is bisected by a number of dirt roads that receive a high amount of recreational use from OHVs, hikers, and mountain bikes. *Taeniatherum caput-medusae* is established in dense patches throughout this population (Bergstrom 2009, p. 9). In 2007, this area was slated for subdivision development, but this has been delayed (Wood Rogers 2007, Tables 2 and 3, pp. 5–6). In 2012, a wildfire burned through this population (BLM, Geospatial Data 2012b). A 2013 survey confirmed that the species still persisted at this location; however, infestation by *T. caput-medusae* is much worse and may have already outcompeted I. webberi in portions of this population (S. Kulpa, E. Bergstrom, and C. Ghiglieri, unpubl. survey 2013). Although this population may meet the criteria for a rank of "A" in terms of number of individuals, the extent of the infestation from *Taeniatherum caput-medausae* prompts us to assign a rank of "AC" to this population. .

USFWS 15 – The Pines Powerline

USFWS 15 occurs on private lands. This population occupies 0.14 ac (0.06 ha) or 0.08 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This population was discovered in 2006 during pre-construction surveys for a proposed housing development that has since been delayed. It was estimated to contain 63,300 individuals (J. Picciani, unpubl. survey 2006; Wood Rogers 2007, Tables 2 and 3, pp. 5–6). This population is bisected by a number of dirt roads that receive a high amount of recreational use from OHVs, hikers, and mountain bikes. *Taeniatherum caput-medusae* is established in dense patches throughout this population (Bergstrom 2009, p. 9). In 2011, a wildfire burned through this population (BLM, Geospatial Data 2012b), and a 2013 survey confirmed that this species still persisted at this location (S. Kulpa and E. Hourihan, unpubl. survey 2013). Although this population may meet the criteria for a rank of "A" in terms of number of individuals, the acreage occupied and the extent of the infestation from *Taeniatherum caput-medausae* prompts us to assign a rank of "AC" to this population.

USFWS 16 – Dante Mine Road

USFWS 16 represents the only occurrence in Douglas County, Nevada, and it is the southernmost extent of the distribution of *Ivesia webberi*. It occurs on a combination of BLM and private lands. This population occupies 0.56 ac (0.23 ha) or 0.34 percent of the total amount of occupied habitat mapped for *I. webberi*. This population has been surveyed seven times (1991, 1997, 2004, 2005, 2010, 2011, and 2012). The 1991 survey estimated 10,000 individuals (C. Witham and G. Kareofelas, unpubl. survey 1991h), while the 1997 survey estimated 36,500 individuals (C. Witham, unpubl. survey 1997d). The 2004, 2005, and 2010 surveys all estimated 23,000 individuals (J. Morefield, unpubl. survey 2004; J. Morefield, unpubl. survey 2005; J. Morefield, unpubl. survey 2010b). Both the 2011 and 2012 surveys utilized randomly placed 3.3 ft^2 (1 m^2) quadrats to extrapolate plant density estimates (D. Tonenna, BLM, pers. comm. 2012). The 2011 survey was only a partial survey and estimated 3,179 individuals (BLM, unpubl. survey, 2011), while the 2012 survey was a complete survey and estimated 18,399 individuals (BLM, unpubl. survey 2012a). Roads define the western and northern perimeters of the population, but the population does not extend into the Highway 395 right-of-way. *Bromus tectorum* is present within this population (J. Morefield, unpubl. survey 2004). In 2012, a wildfire burned through this population; follow-up surveys suggest that the fire severity was light and likely did not damage *I. webberi*, but some of the emergency fire suppression activities may

have (D. Tonenna, pers. comm. 2012). Although this population may meet the criteria for a rank of "A" in terms of number of individuals, the small extent of occupied habitat and presence of nonnative, invasive plant species prompts us to assign a rank of "C" to this population.

USFWS 17 – American Valley

USFWS 17 is known from a historical collection from 1886 (Witham 2000, Appendix 1, p. 2). Survey work in 1990 indicated that areas that had the most potential suitable habitat for *Ivesia webberi* were already developed, and they are now part of the town of Quincy. No *I. webberi* was encountered in these areas, nor were any known plant associates (Duron 1990, p. 13). Based upon this information and the above EO rank criteria, we assigned a rank of "X" to this population.

Summary of Populations

A total of 21 occurrences make up the 17 known *Ivesia webberi* populations (Table 1 and Figure 2). One population (USFWS 17) is extirpated. Of the remaining 16 populations, the status of 2 is unknown because both (USFWS 2 and 6) have such limited data their relative viability cannot be determined. Fourteen of the populations (containing a total of 19 occurrences) can be assessed in terms of their relative viability or habitat. Of these, a portion of one population (USFWS 5–subpopulation Dog Valley Meadow) meets the "A" (excellent viability) ranking criteria. Two populations (USFWS 14 and 15) are ranked "AC" (excellent to fair viability). One population (USFWS 8) and a portion of another (USFWS 5–subpopulation Upper Dog Valley) are ranked "BC" (good to fair viability). One subpopulation (USFWS 7–Halfway Slope) is ranked "H" (historical) due to development. The remaining 10 populations (containing a total of 13 occurrences) are ranked "B" (good viability; 2 populations), "C" (fair viability; 3 populations and 3 subpopulations), and "D" (poor viability; 3 populations and 2 subpopulation).

CONSERVATION ACTIONS AND EFFORTS

USFS Conservation Strategy

The USFS has management authority for the majority of *Ivesia webberi* populations (i.e., 8 of the 16 extant populations), and prepared a Conservation Strategy (CS) for this species in 2009 (Bergstrom 2009, pp. 1–46) that was signed in 2010. The CS identifies existing and potential concerns on Federal, State, and private lands including recreational impacts from OHVs; land and road development; nonnative, invasive plant species; wildfire; livestock grazing; climate change; and other natural factors. The overall resource management objective is to maintain the viability of *I. webberi* populations and effectively prevent its potential decline consistent with Forest Service Manual 2672.1 and the Toiyabe National Forest Land and Resource Management Plan (USFS 1986, p. IV-51). The CS proposes 10 management measures to achieve this objective: (1) Maintain current populations; (2) design actions to prevent loss of habitat, including priority potential habitat; (3) implement the CS; (4) coordinate with other Federal and State agencies and city and county governments; (5) conduct demographic and plant community monitoring on USFS lands; (6) close or reroute existing roads and trails to avoid populations; (7) develop management options for priority potential habitat areas on the National Forest for the purpose of developing an out-planting program; (8) maintain site-specific survey standards for

all projects proposed within potential habitat; (9) highlight conservation and management of occupied and potential habitat through the Forest Plan Revision including an evaluation of the opportunity to close all or portions of grazing allotments, or the addition of exclosures to address the threat posed by livestock; and (10) collection and long-term storage of seed in an appropriate repository (Bergstrom 2009, pp. 28–30).

The CS addresses the entire range of *Ivesia webberi*, and the USFS implements conservation actions on their lands. Of the proposed management measures in the CS, 13 of the 39 location-specific actions for *I. webberi* on USFS land have been funded and implemented, as highlighted in Appendix A, Table 1.A. (E. Bergstrom, USFS, pers. comm. 2012). At least one location-specific management action has been implemented at five populations to help ameliorate impacts to the species including impacts from roads and/or nonnative, invasive species. For example, barriers have been created on a campground access road that goes through one of three populations on USFS lands (USFWS 5–subpopulation Upper Dog Valley) crossed by roads, but the roads within the remaining two populations are still open or unbarricaded. The USFWS is partnering with the USFS to close or barricade roads within one of the two other populations (USFWS 13) crossed by roads, although implementation of this work has not begun. Nonnative, invasive plant species are present at all eight populations on USFS land and treatments have been initiated at two populations. Demographic monitoring called for in the CS is inherently labor-intensive and full implementation has yet to be achieved as a result of funding and manpower constraints. The CS will likely result in long-term benefits to *I. webberi*, although threats such as nonnative, invasive plant species such as *Bromus tectorum* and *Taeniatherum caput-medusae* and modified fire regime have landscape-scale impacts that will continue to present challenges to *I. webberi* conservation.

BLM

The BLM has management authority for 4 of the 16 populations of *Ivesia webberi*. A formal conservation strategy for this species on BLM lands has not yet been developed, although the Carson City BLM office monitored population USFWS 16 in 2011 and 2012 (D. Tonenna, pers. comm. 2012; BLM, unpubl. survey 2012a). As discussed below, this population is subject to threats from wildfire, nonnative, invasive plant species, and development.

FACTORS AFFECTING THE SPECIES

Ivesia webberi has specialized habitat requirements, as described above, that restrict its distribution along a relatively narrow corridor on the eastern edge of the northern Sierra Nevada and the northwestern edge of the Great Basin Desert (Figure 2). Within this landscape, several factors are currently altering habitat structure and composition to the general detriment of native species, including *I. webberi*. Specific examples of such factors include: (1) nonnative, invasive plant species, (2) modified wildfire regimes, (3) OHV use and road development, (4) other forms of development associated with agricultural, residential, or other land use, and (5) livestock grazing. Lastly, climate change may influence the degree to which many of these threats, individually or collectively, may affect *I. webberi*. We discuss the manner in which these factors

are affecting *I. webberi* in the following paragraphs.

Nonnative, Invasive Plant Species

Nonnative, invasive plant species, such as *Bromus tectorum* (cheatgrass), *Taeniatherum caput-medusae* (medusahead), and *Poa bulbosa* (bulbous bluegrass) have become established and are part of the associated plant community at 12 of the 16 extant *Ivesia webberi* populations (USFWS 1, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16). Nonnative, invasive plant species negatively affect *I. webberi* due to increased wildfire frequency (see *Modified Wildfire Regime* below), altered ecological function, competition with and displacement of native plant species, and degradation of the quality and composition of the *Artemisia arbuscula*-perennial bunchgrass-forb habitat in which *I. webberi* occurs (D'Antonio and Vitousek 1992, pp. 68–72; Gonzalez *et al.* 2008, entire; Mazzola *et al.* 2011, pp. 514–515; Pierson *et al.* 2011, entire). In addition, most climate change models project conditions conducive to the further spread of nonnative, invasive annual grasses (like *B. tectorum* and *T. caput-medusae*; see *Climate Change* below; Chambers and Pellant 2008, p. 32; Bradley *et al.* 2010, pp. 312–316; Balch *et al.* 2013, pp. 179–183).

Bromus tectorum displaces native plants, such as *Ivesia webberi*, by prolific seed production, early germination, and competitive abilities for the extraction of water and nutrients (Rice *et al.* 1992, entire; Pellant 1996, pp. 3–4; Chambers *et al.* 2007, pp. 117–120, 141–142). For example, *B. tectorum* soil seed banks can range from 5,000 to 15,000 seeds/m², which ensures high propagule pressure on native species (Humphrey and Shupp 2001, pp. 88–90; Mazzola *et al.*, 2010, p. 523). Bradley and Mustard (2006, p. 1146) found that the best indicator for predicting future invasions of *B. tectorum* was the proximity to current infestations of this species. Twelve of the 16 extant populations of *I. webberi* (USFWS 1, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16) have already been invaded by *B. tectorum*. The remaining four *I. webberi* populations (USFWS 2, 3, 4, and 6) are within 1 to 15 mi (1.6 to 24.1 km) of populations already infested by *B. tectorum*, and it is likely that *B. tectorum* is present within the intervening habitat.

Taeniatherum caput-medusae overlaps in distribution and habitat requirements with *Bromus tectorum*. *Taeniatherum caput-medusae* cover increases and spreads rapidly under a frequent wildfire regime, and may even out-compete *B. tectorum* (Archer 2001, entire; Brooks and Pyke 2001, p.5). *Taeniatherum caput-medusae* seeds can germinate in fall, winter, or spring, and seedlings can produce flowers and seeds throughout the growth season (Young 1992, p. 247). When dry, *T. caput-medusae* vegetation decomposes slowly, allowing it to build a thick mat of dead or dying vegetation that suppresses growth and recruitment in native species, eventually effectively eliminating them (Davies 2008, pp. 110–111). Five of the 16 extant populations of *I. webberi* (USFWS 9, 10, 13, 14, and 15) have been infested with *T. caput-medusae* and are within 2 mi (3.2 km) of 4 additional *I. webberi* populations (USFWS 6, 7, 8, and 12) that currently lack *T. caput-medusae*.

Poa bulbosa is a nonnative, invasive grass found within one *Ivesia webberi* population (USFWS 5) and occurs within the meadow community in areas of past disturbance and along some abandoned irrigation ditches (Bergstrom 2009, p. 11). Like *Bromus tectorum* and *Taeniatherum caput-medusae*, *P. bulbosa* germinates early and is often the first invading species on shallow soils that are moist only during the spring (Locke and Burrill 1994, p. 1). Since *P. bulbosa*

prefers vernally moist shallow soils similar to areas occupied by *I. webberi*, there is potential for future displacement of *I. webberi*.

Conservation measures designed to reduce the threat of nonnative, invasive plant species are addressed in the USFS CS for *Ivesia webberi* (Bergstrom 2009, pp. 28–39). Invasive plant species are present at all eight populations of *Ivesia webberi* on USFS land. The USFS CS includes conservation measures to control and treat populations of *Poa bulbosa* at USFWS 5 and *Taeniatherum caput-medusae* at USFWS 13. *Taeniatherum caput-medusae* at USFWS 10 was also treated, even though this population was discovered after completion of the CS. Controlling or eliminating nonnative, invasive plants from *I. webberi* habitat or ecosystems surrounding its habitat is a significant challenge due to the vast spatial scale of the problem, logistical and budgetary constraints, and the evolving methodology for restoring ecosystems back to their natural condition (Richards *et al*. 1998, entire; D'Antonio and Chambers 2006, pp. 260–279).

Nonnative, invasive plant species pose a threat to *Ivesia webberi* because they have the ability to overtake and displace *I. webberi* from its habitat, while contributing to increases in the frequency, spatial extent, and severity of wildfires. At this time, there are no feasible means for controlling the spread of *Bromus tectorum*, *Taeniatherum caput-medusae* on a landscape-scale basis or the subsequent increases in wildfire frequency (see *Modified Wildfire Regime* below). Therefore, based on the lack of effective landscape-scale control mechanisms, the demonstrated invasion of nonnative plants in the range of the species, and the likely increases in cover of these species based on their successful invasive characteristics, we expect the threat from nonnative, invasive plant species to continue and likely increase in the future within the range of *I. webberi*.

Modified Wildfire Regime

Wildfire was historically infrequent in the Great Basin because the native plant communities made up of annuals and perennial bunchgrasses did not provide sufficient fine fuels to carry large-scale wildfires (Whisenant 1990, p. 6; D'Antonio and Vitousek 1992, pp. 74–75; Brooks and Pyke 2001, p. 5). The bare spaces between widely-spaced shrubs and the low fuel load of the native annuals and perennial bunchgrasses generally prevented fire from spreading, and fires that did burn were restricted to isolated patches (Whisenant 1990, p. 6; Brooks and Pyke 2001, p. 5). The historic fire return interval for *Artemisia tridentata* communities is typically between 30 and 70 years (Whisenant 1990, p. 4). However, in *Artemisia arbuscula* communities, mean fire return intervals are considerably longer than in *Artemisia tridentata* communities due to lower productivity and fuel accumulations (Miller and Rose 1999, p. 557; Knick *et al*. 2005, p. 5). For instance, in *Artemisia arbuscula-Poa secunda* communities such as those in which *Ivesia webberi* occurs, the average historic fire return interval is probably greater than 100 years (Young and Evans 1981, pp. 501–505; Miller and Rose 1999, p. 557).

Beginning in the late 1800s, the widespread invasion of nonnative plant species, particularly annual grasses such as *Bromus tectorum* and *Taeniatherum caput-medusae*, has created a bed of continuous fine fuels across the sagebrush landscape in many areas (D'Antonio and Vitousek 1992, 73; Knapp 1996, p. 45; Brooks *et al*. 2004, entire; Davies *et al*. 2011, p. 2575). This has resulted in more frequent fires due to greater horizontal fuel continuity, increased fuel surface-to-volume ratio, and lower fuel (i.e., plant tissue) moisture content and thus increased flammability

(Brooks *et al*. 2004, pp. 679–680). Past wildfires likely had a minimal impact on *Ivesia webberi* due to the sparsely vegetated, rocky habitat and lower fuel accumulations within this species' habitat (Bergstrom 2009, p. 23). However, the spread of nonnative, invasive plant species into *I. webberi* habitat and adjacent plant communities has altered historic fire regimes by contributing to more frequent wildfires that burn more intensely. Not only could wildfires kill *I. webberi* individuals, higher-severity wildfires are more likely to consume *I. webberi* seedbanks, resulting in reduced likelihood of regeneration and recruitment in *I. webberi* populations impacted by fire.

Post-fire conditions facilitate the invasion and establishment of nonnative plant species, thus creating a positive feedback loop between increased fire frequencies and the spread of nonnative, invasive, annual grasses (D'Antonio and Vitousek 1992, 73; Brooks and Pyke 2001, p. 5; Brooks *et al*. 2004, p. 678). Nonnative, invasive plants promote recurrent fires, which in turn convert high-diversity native communities to low-diversity communities dominated by nonnative species; these communities then burn more frequently and eventually create a monoculture of nonnative, invasive species, displacing native species, including *Ivesia webberi*. Ten *I. webberi* populations have already experienced wildfire: USFWS 3 and 4 (burned in 1997), USFWS 7, 8, 9, and 10 (burned in 1984), USFWS 11 (burned in 1999), USFWS 14 and 16 (burned in 2012), and USFWS 15 (burned in 2011) (BLM, Geospatial Data 2012b). At populations USFWS 3 and 4 *I. webberi* could not be relocated the year following the 1997 wildfire event that burned through these populations, despite the fact that these surveys were conducted during the appropriate time of year by qualified personnel (Sustain Environmental Inc. 2009, p. III-19). Both populations were verified to still be extant in 2013 (S. Kulpa and J. Johnson, unpubl. survey 2013a and 2013b), however whether or not population size (number of plants) was appreciably affected by this wildlife event cannot be evaluated from available survey data. Additionally, a 1999 wildfire (BLM, Geospatial Data 2012b) burned USFWS 11 and plants were subsequently discovered here in 2010 (J. Morefield, unpubl. survey 2010a). This suggests that this species may be able to persist after some fire events, though persistence is likely dependent on fire severity, frequency and timing (time of year). Additionally, *Bromus tectorum* (USFWS 7, 8, 9, 10, 11, 14, 15, and 16) and/or *Taeniatherum caput-medusae* (USFWS 9, 10, 14, and 15) has been documented within all *I. webberi* populations that have experienced fire, as well as within several populations that haven't yet burned (USFWS 1, 5, and 13).

As the urban interface continues to expand into wildlands, wildfire suppression activities required to protect human life and property will intensify, increasing the likelihood of potential impacts from suppression activities to *Ivesia webberi* and its habitat (Witham 2000, p. 22). The relatively flat and accessible terrain of *I. webberi* habitats provides convenient areas on which to establish staging areas for wildfire suppression activities (Witham 2000, p. 22; Bergstrom 2009, p. 22). Wildfire suppression activities could result in *I. webberi* plants being trampled, soils being disturbed or compacted, and invasive, nonnative plant species being spread into areas disturbed by suppression activities. In 2012, a wildfire burned through USFWS 16 and follow-up surveys suggest that the fire was slight and likely did not damage plants, but some of the suppression activities may have (D. Tonenna, pers. comm. 2012). *I. webberi* populations within the Peavine Mountain area close to the Reno urban area (USFWS 8, 11, 12, 13, 14, and 15) are most susceptible to threats from suppression activities due to the proximity of the area to the urban interface, increased human use of the area, and the higher frequency of fire within this area (Bergstrom 2009, p. 8).

As the coverage of nonnative, invasive species continues to increase in these areas, it is reasonable to expect that these *Ivesia webberi* populations that have already experienced wildfire, will experience it again, given the demonstrated positive feedback cycle between wildfire and nonnative, invasive species (D'Antonio and Vitousek 1992, p. 73; Brooks and Pyke 2001, p. 5; Brooks *et al.* 2004, p. 678; Balch *et al.* 2013, pp. 180–182). Also, climate change models project a likely increase in fire frequency within the range inhabited by *I. webberi* (see *Climate Change* below). Thus, wildfire contributes to increases in the establishment and spread of nonnative, invasive species within the range of *I. webberi*, which further increases the likelihood of more frequent and intense wildfires across its range, which also increases the likelihood of potential impacts from wildfire suppression activities.

Off Highway Vehicle Use and Road Corridors

In the past 10 to 20 years, with the growth of the human population and associated development, OHV impacts have increased in *Ivesia webberi* habitat (Bergstrom 2009, p. 22). Eleven *I. webberi* populations (USFWS 1, 5, 7, 8, 9, 11, 12, 13, 14, 15, and 16) are adjacent to and/or are intersected by dirt roads, and have been affected to some degree by road development and OHV use (Table 1; Witham 2000, p. 22; J. Morefield, unpubl. survey 2010a, S. Kulpa, unpubl. data 2012; C. Schnurrenberger, unpubl. survey 2013). Authorized and unauthorized roads have caused loss, degradation, and fragmentation of *I. webberi* habitat. Roads can alter the hydrology of a site, and compacted road surfaces can limit *I. webberi* population expansion. In addition, vehicles often leave the road, compacting soils, crushing plants, and providing a means for nonnative plant species to invade otherwise remote, intact habitats (Witham 2000, Appendix 1, p. 1; Bergstrom 2009, pp. 25–26). Brooks and Lair (2005, p. 8) and others (Brooks and Pyke 2001, p. 4; Gelbard and Belnap 2003, entire) found that vehicular pathways are the primary pathway for nonnative, invasive plant species into arid and semi-arid systems because vehicles serve as the dispersal vector for nonnative, invasive propagules, and disturbance within vehicle routes facilitate the establishment of invading plant species. Fire frequency has also been shown to be higher in areas of OHV use (Brooks and Pyke 2001, p. 4). Witham (2000, p. 21) has observed permanent loss of plants where OHV disturbance has been continuous, such as on well-used road beds bisecting habitat.

The 2006 USFS Travel Management Plan (TMP) for Peavine Mountain, an area which encompasses nine populations of *Ivesia webberi* on both public and private lands (USFWS 5, 7, 8, 9, 10, 12, 13, 14, and 15) includes provisions that designate motorized and non-motorized trails, and prohibits motor vehicle use off of designated routes (USFS 2006a, pp. 1–8). An Environmental Assessment prepared for this action concluded that USFS Sensitive Species, *I. webberi* included, may be impacted if inadvertent or illegal trampling occurs, but that the closure and rerouting of roads would ultimately benefit sensitive plant populations by reducing the threat of trampling and by allowing native and rare plant communities to be restored (USFS 2006b, p. 23). In 2008, the USFS published a Motor Vehicle Use Map (MVUM) for Peavine Mountain and other areas, reflecting (in part) the 2006 TMP for Peavine Mountain (USFS 2009, p. 1). The TMP and MVUM for Peavine Mountain are intended to benefit rare plants because motor vehicle use off of designated routes is prohibited. Designated roads open to all vehicles; however, continue to bisect certain *I. webberi* populations. For instance, USFS Route number

#41645 bisects USFWS 12 and USFS Routes #21549 and #21550 bisect USFWS 13 (USFS 2012b; *http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5305083.pdf*, accessed on November 20, 2012). Unauthorized OHV use remains particularly high within *I. webberi* populations on USFS lands close to the Reno urban area (USFWS 8, 12, and 13), likely due to limited enforcement resources (Reno Gazette-Journal 2007, 2012).

Development

Development for agricultural, residential, commercial, or other purposes can affect *Ivesia webberi* through various forms of habitat loss, degradation, or fragmentation. Impacts can be direct in the form of uprooting or burying plants and their propagules beneath overturned soils, and the permanent conversion of habitat to non-suitable conditions or indirect, through increased nonnative plant invasions, OHV use, and/or human-caused wildfire. Development has resulted in the extirpation of one *I. webberi* population (USFWS 17) and likely a portion of another (USFWS 7–subpopulation Halfway Slope). We review the various forms of ongoing or planned development activities at remaining *I. webberi* populations below.

Public land development

The USFS has proposed to authorize construction and operation of approximately 10 mi (16 km) of new 120-kV overhead transmission line between NV Energy's Bordertown and California Substations (USFS 2012a, entire). The majority of the preferred route – the Stateline alignment – would cross USFS land (approximately 7 mi (11.3 km)), with shorter segments crossing private land (approximately 2.5 mi (4 km)) and BLM land (approximately 0.5 mi (0.8 km)) (USFS 2011, p. 1). This preferred alternative would bisect two *Ivesia webberi* populations (USFWS 9 and 10) and parallel a portion of a third (USFWS 7–subpopulation Three Pines Flat).

Three alternative alignments are being considered: Mitchell, Peavine, and Poeville. The Mitchell Alignment is 10.8 mi (17.4 km) long and crosses an area previously disturbed by wildfire and uses existing transmission corridors. The Peavine Alignment is 10.3 mi (16.6 km) and crosses through *Artemisia tridentata* habitat, and is the most visually-sensitive alignment for approximately 0.50 mi (0.8 km) of the route. The Poeville Alignment is the longest route (18.5 mi (29.8 km) but would be located within existing transmission line corridors and reduce the total miles crossing USFS land (USFS 2011, p. 2). With regard to potential adverse effects to *I. webberi*, the Mitchell alignment is not appreciably different from the preferred alternative (i.e., it would bisect populations USFWS 9 and 10 and parallel the Three Pines Flat subpopulation of USFWS 7). The Peavine alignment would parallel two portions of population USFWS 7 (subpopulations–Halfway Slope and Jeffrey Pine Saddle). However, the Poeville alignment would not impact any of the *I. webberi* populations.

If *Ivesia webberi* plants are not avoided during construction, they would likely be uprooted or buried, resulting in plant mortality or destruction of seeds or propagules, and the possible extirpation of entire population or subpopulations. With the exception of the Poeville alignment (which would not affect *I. webberi* populations), the preferred and alternative alignments would require the construction of temporary roads within or in close proximity of existing *I. webberi* populations. As previously discussed, roads degrade and fragment habitat by creating pathways

for the spread of nonnative species and facilitating OHV activity (Witham 2000, Appendix 1, p. 1; Bergstrom 2009, pp. 25–26). *Taeniatherum caput-medusae* (a nonnative, invasive, annual grass discussed above in *Nonnative, Invasive Plant Species*) is already established within and surrounding populations USFWS 9 and 10, and further soil disturbance in the vicinity of this species is likely to facilitate its expansion into *I. webberi* populations, potentially resulting in displacement of *I. webberi* in these areas (Witham 2000, Appendix 1, p. 1; Bergstrom 2009, pp. 25–26). Access roads created for the construction or maintenance of this transmission line are also prone to subsequent, unauthorized use by OHV activity, which (as discussed above) not only serves as a source of direct plant mortality (through uprooting or crushing established individuals), but contributes to other threats by facilitating the spread of nonnative, invasive plant species, and thus accelerating the positive feedback loop between nonnative species and wildfires.

The final location of the transmission line has not been selected. The USFS is currently analyzing this project and the Final Environmental Impact Statement should be complete in December 2013.

Private land development

There is ongoing or planned residential and/or commercial development at all *I. webberi* populations in Nevada that occur on private lands (USFWS 7, 14, 15, and 16). All or substantial portions of four populations (USFWS 7, 14, 15 and 16) occur on private lands within the greater metropolitan area of Reno, Nevada (Table 1, Figure 2). We discuss the development threat posed to each of these populations below.

Population USFWS 7 spans the California-Nevada State line and consists of four subpopulations (Table 1; Figure 2). One of its subpopulations (Mules Ear Flat) is located on USFS lands in California; the remainder of the population (subpopulations–Three Pine Flat, Halfway Slope, and Jeffrey Pine Saddle) is located on private lands in Nevada on 1.9 ac (0.77 ha) of habitat. The Nevada parcels comprising these three subpopulations consisted of undeveloped rural land in 1991, but have since been fenced and new roads have been graded in the area (Witham 2000, p. 22). In 2004, a private residence and road were constructed within the boundaries of one subpopulation (Halfway Slope), likely extirpating this subpopulation. The building permits for this house (issued in 2003) predated the 2004 listing of *Ivesia webberi* by the State of Nevada, therefore no legal protections were in place as of that time (Washoe County 2003, p. 1-2). However, visual inspection of ESRI ArcGIS Imagery Basemap satellite imagery reveals roads immediately adjacent to the two other subpopulations comprising this population (Three Pines Flat and Jeffrey Pines Saddle), illustrating that threats from roads and other forms of private development actions continue to affect this population.

Populations USFWS 14 and 15 occur on private land that has been proposed for development (Witham 2000, Appendix 1, p. 1; Wood Rogers 2007, p. 5). As noted above (Legal Status – State of Nevada), the listing of *Ivesia webberi* by the State of Nevada in 2004 requires that landowners obtain a permit from the Nevada Department of Forestry (NDF) prior to removing or destroying plants of this or any other listed species on their property. A permit application submitted to NDF in November 2007 sought permission to destroy 0.87 ac (0.35 ha) of the 1.49-

ac (0.6 ha) habitat supporting these two populations (Wood Rogers 2007, Tables 2 and 3, pp. 5–6; 2008, Table 3, p. 3). Road alignments will parallel the remaining 0.62 ac (0.25 ha) of habitat. This application was subsequently amended to preserve an additional 0.068 ac (0.028 ha) of habitat within USFWS 14 (now 0.80 ac (0.32 ha) of impacted habitat). The conserved habitat has been degraded by dense stands of *Taeniatherum caput-medusae* and consists of low densities of *I. webberi* (Wood Rogers 2008, Table 3, p. 3). The NDF and the applicant have concluded their negotiations regarding possible modifications to the proposed development to avoid or minimize effects to *I. webberi*, although the USFWS filed comments with NDF expressing continued concerns about the level of impact to this population (USFWS 2008, p. 1). The Conditional Permit for the Disturbance or Destruction of Endangered Species has not yet been issued by NDF, nor have building permits been issued for these parcels (NDF 2008, p. 1; Christopherson 2011; Washoe County Geographic Information System website *http://wcgisweb.washoecounty.us/website/*, accessed on November 19, 2012). While this may reflect a temporary downturn in the local economy and thus rates of home construction, we continue to regard development of this population as a foreseeable threat.

Population USFWS 16 lies about 50 mi (80 km) south of the nearest Reno population in the Pine Nut Mountains in Douglas County, Nevada. One corner of this population is on BLM land; the rest of the population is on private land. Residential development may be a threat to this population, although its proximity to U.S. Highway 95 may make it more valuable for commercial development (Witham 2000, p. 25, Appendix 1, p. 1).

Livestock Grazing

Livestock use has the potential to result in negative effects to *Ivesia webberi*, depending on factors such as stocking rate and season of use. Evidence of significant herbivory on *Ivesia webberi* has not been observed (Witham 2000, p. 20). Impacts from cattle use are primarily from trampling and substrate disturbance (Witham 2000, p. 20; S. Kulpa, unpubl. data 2012). Livestock use has also been suggested as a contributing factor to the spread of nonnative, invasive plant species (Young *et al*. 1972, entire; Hobbs and Huenneke 1992, p. 329; Loeser *et al*. 2007, pp. 94–95). The gentle topography within *I. webberi* habitat may make population areas attractive for permittees to install salt licks, fences, and other range modifications that concentrate livestock and thus trampling impacts (Witham 2000, p. 21); however, we have not documented such impacts to *I. webberi*.

Livestock grazing currently occurs on BLM land at two populations (USFWS 1 and 11). Grazing on these lands is regulated under the Federal Land Policy Management Act (FLPMA), which is a multiple-use mandate that allows for various activities such as grazing, mining, OHV recreation, as well as resource conservation actions, on BLM land. Under FLPMA, BLM has the ability to establish and implement special management areas such as Areas of Critical Environmental Concern to reduce or eliminate actions that adversely affect species of concern, such as *Ivesia webberi*; however, there are no special management designations for *I. webberi* on any BLM lands.

At this time, livestock grazing is not occurring within or near *Ivesia webberi* populations on USFS land. Seven populations (USFWS 5, 6, 7, 8, 9, 10, and 12) occur within historic grazing

allotments which are currently vacant (Bergstrom 2009, p. 27). None of these allotments have been formally closed to grazing; therefore, these allotments could be restocked in the future to alleviate grazing pressures or other constraints elsewhere across the Humboldt-Toiyabe National Forest. This would be analyzed through a NEPA Range Recession process scheduled for the Carson Ranger District in 2016 (Bergstrom 2009, p. 27).

Climate Change

Our analyses under the Endangered Species Act include consideration of ongoing and projected changes in climate. The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). "Climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78).

Scientific measurements spanning several decades demonstrate that changes in climate are occurring, and that the rate of change has been faster since the 1950s. Examples include warming of the global climate system, and substantial increases in precipitation in some regions of the world and decreases in other regions (For these and other examples, see IPCC 2007, p. 30; and Solomon *et al*. 2007, pp. 35–54, 82–85). Results of scientific analyses presented by the IPCC show that most of the observed increase in global average temperature since the mid-20th century cannot be explained by natural variability in climate, and is "very likely" (defined by the IPCC as 90 percent or higher probability) due to the observed increase in greenhouse gas (GHG) concentrations in the atmosphere as a result of human activities, particularly carbon dioxide emissions from use of fossil fuels (IPCC 2007, pp. 5–6 and figures SPM.3 and SPM.4; Solomon *et al*. 2007, pp. 21–35). Further confirmation of the role of GHGs comes from analyses by Huber and Knutti (2011, p. 4), who concluded it is extremely likely that approximately 75 percent of global warming since 1950 has been caused by human activities.

Global climate projections are informative, and, in some cases, the only or the best scientific information available for us to use. However, projected changes in climate and related impacts can vary substantially across and within different regions of the world (e.g., IPCC 2007, pp. 8–12). Therefore, we use "downscaled" regional projections when they are available and have been developed through appropriate scientific procedures, because such projections provide higher resolution information that is more relevant to spatial scales used for analyses of a given species (see Glick *et al*. 2011, pp. 58–61, for a discussion of downscaling).

In the Great Basin, where *Ivesia webberi* occurs, temperatures have risen 0.9 to 2.7 °F (0.5 to 1.5°C) and are projected to warm another 3.8 to 10.3 °F (2.1 to 5.7 °C) over the rest of the century (Chambers and Pellant 2008, p. 29; Finch 2012, p. 4). Winter temperatures are projected to increase by 3.6 to 16.2 °F (2 to 9 °C), which will change the balance of temperature and precipitation resulting in earlier spring snow runoff (Stewart *et al*. 2005, p. 1152), declines in snowpack (Knowles *et al*. 2006, p. 4557; Mote *et al*. 2005, entire), and increased frequency of

drought and fire events (Seager *et al.* 2007, pp. 1181–1184; Littell *et al.* 2009, pp. 1014–1019; Abatzoglou and Kolden 2011, pp. 474–475). Under projected future conditions, the cover of sagebrush in the Great Basin region is anticipated to be dramatically reduced (Neilson *et al.* 2005, p. 154). Warmer temperatures and greater concentration of atmospheric carbon dioxide create conditions favorable for nonnative, invasive plant species, such as *Bromus tectorum*, potentially exacerbating the positive feedback cycle between invasive annual grasses and fire frequency (Chambers and Pellant 2008, p. 32; Bradley *et al.* 2010, pp. 312–316; Balch *et al.* 2013, pp. 179–183).

Plant species, such as *Ivesia webberi*, that have a restricted range, specialized habitat requirements, and limited recruitment and dispersal have a higher risk of extinction due to demographic uncertainty and random environmental events (Shaffer 1987, pp. 69–75; Lande 1993, pp. 911–927; Hawkins *et al.* 2008, pp. 41–42). The potential for a population to adapt in a changing climate will be in part determined by the lifespan of the species and the age at which it reaches reproductive maturity, which are not known for *I. webberi* (Jump and Peñuelas 2005, p. 1013). Increasing temperatures and drought frequency could adversely affect *I. webberi* by causing physiological stress, altering phenology, and reducing recruitment events and/or seedling establishment (Parmesan 2006, pp. 642–644; Hawkins *et al* 2008, pp. 16–32). Human-modified landscapes have modified and fragmented *I. webberi* habitat such that gene flow between populations may be reduced, which may affect the species' ability to adapt to a changing climate (Jump and Peñuelas 2005, p. 1014; Haskins and Keel 2012, p. 230). Some plant species may not be able to adapt quickly enough to match the pace or magnitude of climate change (Jump and Peñuelas 2005, p. 1016), or they may not have the genetic diversity or capability to adapt or persist at their current location (Haskins and Keel 2012, p. 230).

The direct, long-term impact from climate change to *Ivesia webberi* is yet to be determined. However, as described above, the invasion of nonnative plant species and the associated wildfire regime changes currently pose a threat to *I. webberi* and the habitat in which it resides. Under current climate change projections, we anticipate that future climatic conditions will favor invasion by nonnative plant species that fire frequency will continue to increase and the extent and severity of fires may increase as well. The alteration of precipitation and temperature patterns as a result of climate change also may result in decreased survivorship of *I. webberi* by causing physiological stress, altered phenology, and reduced recruitment events and/or seedling establishment. Climate change thus may exacerbate impacts from other factors currently affecting *I. webberi* and its habitat such as invasive plants and increased wildfire frequency.

Summary of Factors Affecting the Species

Nonnative, invasive plant species and a modified fire regime are impacting the quality and composition of the *Artemisia arbuscula*-perennial bunchgrass-forb habitat where *Ivesia webberi* occurs. Nonnative, invasive plant species can outcompete and displace *I. webberi* from its habitat, while high-intensity or frequent wildfires can kill *I. webberi* plants and destroy the seedbank. Ten *I. webberi* populations have already experienced a wildfire and 12 populations are invaded by nonnative, invasive plant species. Because there are no feasible means for controlling the spread of nonnative, invasive species given their extent and rapid rate of spread across the Great Basin landscape, we expect the likelihood that future wildfires will degrade *I.*

webberi habitat will increase as well. Additionally, as wildfire frequency increases, the potential for damage to *I. webberi* and its habitat from wildfire suppression activities also increases due to the relatively flat and accessible terrain in which it inhabits. Therefore, we expect impacts caused by the interaction between nonnative, invasive plant species and wildfire to continue and likely increase within the range of *I. webberi*.

During the past 10 to 20 years, the urban interface has expanded into *Ivesia webberi* habitat, leading to increased OHV use and road corridors in these areas. OHV use and road corridors are impacting 11 of the 16 populations of *Ivesia webberi*. These activities can kill or damage individual plants, and modify habitat by compacting soils, and fragmenting both occupied and potential habitat, which in turn precludes or reduces potential recruitment and population expansion of *I. webberi*. OHV and other road corridors also create vectors for nonnative, invasive plant species to invade otherwise remote, intact habitats. Since the urban interface will continue to expand, we expect the threat from OHVs and road corridors to continue and likely to increase within the range of *I. webberi.*

At seven populations of *Ivesia webberi*, development either has already occurred, or is being planned. Development can cause various forms of habitat loss, degradation, and fragmentation. Development impacts to *I. webberi* range from direct mortality (from uprooting, burying, or killing individuals) to the facilitation of nonnative, invasive plant species infestations and human-caused wildfires, which further fragments and isolates remaining populations. The impact of development has resulted in the permanent loss of *I. webberi* and its habitat, such as was the case for one population (USFWS 17) and the likely case for the presumed loss of a portion of another (USFWS 7, subpopulation Halfway Slope). Although the populations most likely to be developed occur on private land (USFWS 14 and 15) and are relatively small, these represent some of the highest-density populations of *I. webberi* across the species' range. In addition to the threat of development on private lands, the proposed NV Energy Bordertown to California transmission line may impact three populations distributed across a combination of public and private lands. Therefore, we regard development as likely to affect portions of six populations across the range of the species.

Livestock grazing may result in direct impacts to individual *Ivesia webberi* plants due to trampling, while also creating patterns of soil disturbance that in turn alter habitat function and create conditions conducive to the invasion of nonnative plant species. Two *I. webberi* populations are currently grazed by cattle. Another seven populations occur within vacant grazing allotments that are not currently affected by grazing, but that could be re-opened (to grazing) to alleviate pressures on other, nearby grazing allotments. Therefore, while grazing is currently not impacting a substantial number of populations, the re-opening of grazing allotments that are currently vacant could increase these impacts to *I. webberi* in the future.

Given current climate change projections, we anticipate that future climatic conditions will favor invasion by nonnative plant species, and contribute to increases in the frequency, spatial extent, and severity of wildfires. The alteration of precipitation and temperature patterns may result in decreased survivorship of *I. webberi* due to physiological stress of individual plants, altered phenology, and reduced seedling establishment and plant recruitment. These alterations in

climatic conditions are likely to exacerbate impacts to *I. webberi* from other factors currently affecting *I. webberi* such as invasive plants and increased wildfire.

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APPENDIX A: Table A.1.

TABLE A.1.—Location-specific actions proposed in the rangewide Conservation Strategy for *Ivesia webberi* (Bergstrom 2009, Appendix 1), and actions implemented to date.

Population (USFWS)	Site Name	Recommended Action	Year Implemented
5	Dog Valley Meadow	Seed collection and long-term storage	2010
		Remove conifer encroachment in and adjacent to meadow	2011
		Establish demographic plots within the population and evaluate yearly	2011, not done in 2012
		Evaluate treatment methods to control Poa bulbosa and implement test plots	not implemented; more research needed on *Poa bulbosa*
		Monitor *Poa bulbosa* treatments	
		Implement control measures for *Poa bulbosa* within the meadow based on test plots	
		Prepare interpretive plan and signing to highlight rare plant resources within the Botanical Area	not implemented
		Complete a pollinator assessment	not yet implemented
		Remove cross-fencing within the meadow system and establish a perimeter fence along meadow boundary	not implemented, funding secured for a portion of fencing in 2013
	Upper Dog Valley	Create a barrier along USFS Route #038 to prevent road access across population	2010
		Effectiveness monitoring of road barriers	2012
		Establish statistical estimate of the population and mark the other boundaries of the occurrence	not implemented
		Monitor the establishment of Poa bulbosa within the population and evaluate Ivesia webberi distribution based on boundary delineation	not implemented
6	White Lake Overlook	Evaluate threats to population and determine possible options for habitat protection	not implemented
		Delineate boundaries of population	not implemented
7	Mules Ear Flat	Evaluate threats to population and determine possible options for habitat protection	not implemented
		Collect demographic and density data using a permanently marked sample of plants	not implemented
		Delineate boundaries of population	not implemented
8	Ivesia Flat	Fencing of population to close non-system bisecting roads	2010
		Seed collection and long-term storage	2010
		Informative signs	2011
		Effectiveness monitoring of habitat improvements	2011 evaluated, fencing was not evaluated in 2012
		Demographic monitoring over 10 years with pollination evaluation	not implemented
9	Stateline Road 1a	Actions not identified in Conservation Strategy because population discovered after 2009	
	Stateline Road 1b	Actions not identified in Conservation Strategy because population discovered after 2009	

10	Stateline Road 2	Actions not identified in Conservation Strategy because population discovered after 2009, however *Taeniatherum caput-medusae* infestation adjacent to rare plants was treated in 2011 by USFS.	
12	Black Springs	Acquire private property adjacent to USFS land with occupied *Ivesia webberi* habitat	2008
		Seed collection and long-term storage	2010
		Boulder placement along the road prism or closure	not implemented
		Establish statistical estimate of the population and permanent photoplots	not implemented
		Effectiveness monitoring of habitat protection measures	not implemented
13	Raleigh Heights	seed collection and long-term storage	2010
		Treatment of *Taeniatherum caput-medusae* surrounding population	on-going
		Demographic monitoring over 10 years with pollination evaluation	not implemented
		Coordinate with a botanical garden or University to conduct a seed bank assessment including germination trials	not implemented
		Close selected roads within population vicinity (roads are part of Peavine TMP)	partially funded by the USFWS; not implemented; requires NEPA
Northern Portion Carson Ranger District Potential Habitat Evaluation		Habitat modeling	being conducted by Nevada Natural Heritage Program
		Field verify potential habitat models	
Peavine Potential Habitat Evaluation		Close 3 non-system roads which influence potential habitat polygons identified by Witham (2000)	not implemented
		Collect seed for nursery cultivation and transplant seedlings to potential habitat polygons	not implemented
		Effectiveness monitoring of habitat protection measures	not implemented
		Transplant site seedling survival surveys	not implemented