LTBMU RARE BOTANICAL SPECIES – 2015 MONITORING REPORT

USDA Forest Service, Lake Tahoe Basin Management Unit

Left to right: *Draba asterophora* var. *asterophora*, *Erigeron miser, Botrychium ascendens*.

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1 EXECUTIVE SUMMARY

This report summarizes the monitoring of status and change of Forest Service Sensitive (FSS) botanical species (vascular and non-vascular plants, lichen, and fungi) and Lake Tahoe Basin Management Unit (LTBMU) Watch List botanical species (WL). On LTBMU, monitoring is limited to FSS and WL botanical species because there are no federally Threatened, Endangered, or Proposed botanical species known to occur on the LTBMU. In 2015, a total of 51 Forest Service Sensitive and watch list sub-occurrences were visited. In 2015, there was not an interagency survey of Tahoe yellow cress.

Overall, the majority of sub-occurrences monitored in 2015 appear to be present, stable or increasing (62%); however, there remains several sub-occurrences that were decreasing (21%). Decreases or species absence were observed for the following species: Galena Creek rockcress, scalloped moonwort, Mingan moonwort, and Tahoe draba. Decreasing or absent sub-occurrences should be prioritized for future monitoring. As feasible, additional monitoring events or types should be implemented for those sub-occurrences and species for which a trend could not be established.

2 INTRODUCTION

The Forest Service is tasked with developing and implementing management practices to ensure that species do not become threatened or endangered due to Forest Service actions (USDA Forest Service 2005). One component of this objective is the designation of Forest Service Sensitive (FSS) species by the Regional Forester; sensitive species are those species identified by the Regional Forester for which population viability is a concern (USDA Forest Service 2013). The goal of FSS designation is to proactively manage species and their habitat, through a variety of associated activities, including analyzing the effects of management activities on FSS, surveying for FSS species, and monitoring known FSS sub-occurrences. The last region wide update of the Region 5 FSS species list was in 2013. Furthermore, LTBMU maintains a Watch List (WL)—those species that are of conservation concern, but have not been designated as Sensitive by the Regional Forester; forest watch lists includes species that are newly described, locally rare, range extensions or disjoint sub-occurrences, plants of specific public interest, or species with too little information to determine their appropriate status (USDA Forest Service 2006).

In order to meet the Forest Service's objectives, in 2004, the Lake Tahoe Basin Management Unit (LTBMU) initiated a comprehensive botanical species (vascular and non-vascular plants, lichen, and fungi) monitoring program. The LTBMU strives to monitor the status and trend of all those botanical species on the Region 5 Regional Forester's Sensitive Species List that are known to occur in the basin (referred to as FSS or 'sensitive'), as well as LTBMU Watch List botanical species. In addition, summaries of each species range, distribution, habitat, threats, and LTBMU status and trend are updated annually to assist in the analysis of effects to these species from management activities.

3 METHODOLOGY

On the LTBMU, monitoring is limited to FSS and WL botanical species because there are no federally Threatened, Endangered, or Proposed botanical species known to occur. There is one Candidate species—whitebark pine (*Pinus albicaulis*)—which is also designated as FSS. Tahoe yellow cress (*Rorippa subumbellata*) was formerly a Candidate species but in 2015 USFWS made the decision not to list it; it remains FSS. Whitebark pine is not currently monitored systematically on LTBMU, but a summary of its

status and trend are included. Tahoe yellow cress (TYC) is monitored annually or bi-annually—depending upon lake levels—by the TYC Adaptive Management Working Group (AMWG); results of the most recent surveys (2012, 2014) are summarized below. Only those species with known occurrences on LTBMU are discussed in detail; there is no discussion for species with only herbarium records (e.g. branch collybia) or suitable habitat (e.g. short-leaved hulsea). APPENDIX A contains a complete list of FSS and WL species targeted for management on LTBMU. In this report, these species—FSS and WL—are sometimes collectively referred to as 'rare plants'.

Across the Forest Service, presence, location, extent, and abundance of rare plants is tracked in the Natural Resource Information System (NRIS)—the Forest Service's database of record for natural resource information (USDA Forest Service 2008). Within NRIS, an Element Occurrence (EO) is defined as an area of land and/or water in which a botanical species is, or was, present. It should be noted that the California Native Diversity Database (CNDDB) also uses the term Element Occurrence, but it is defined differently. CNDDB is the database of record for California's state natural heritage program database and is considered the primary clearinghouse for rare plant spatial data in California (Bittman 2001). Within CNDDB, all occurrences of a given species within ¼ mile of each other are delineated as the same Element Occurrence. LTBMU uses the NRIS definition of an Element Occurrence—a spatially distinct rare plant location, rather than lumping together these locations as CNDDB does; however, in order to track with CNDDB delineation, all NRIS EO within ¼ mile are assigned the same numeric identifier as part of their unique NRIS Site ID to signify that they are part of the same CNDDB EO. For example, DRASA1A and DRASA1B are spatially separate and are considered separate NRIS EO, but occur within ¼ mile of each other, so share the identifier '1'. In this report, the term 'sub-occurrence' refers to an NRIS EO.

LTBMU strives to visit each sub-occurrence at least once every five years. In addition, sub-occurrences are visited more frequently when: 1) new sub-occurrences are discovered (a minimum of two years of baseline data is obtained); 2) data suggests that a sub-occurrence is decreasing; or 3) the status of the sub-occurrence is questionable (e.g. could not be re-located, species identification could not be confirmed, large unexplained year-to-year fluctuation in number of plants). The most recent comprehensive monitoring occurred in 2009. In 2010-2015, revisits were prioritized based upon the criteria above; furthermore, certain sub-occurrences were visited opportunistically in part of pre-project surveys.

Presence, location, spatial extent, and abundance, as well as, changes in existing or potential threats and habitat conditions are recorded at each sub-occurrence. Polygonal GIS data is collected for each sub-occurrence and input along with attribute data into NRIS. Lastly, a Natural Heritage Program (NHP) database record is completed and submitted to the appropriate state program—CNDDB in California and the Nevada Natural Heritage Program (NNHP) in Nevada. Sub-occurrence boundaries are mapped to the best of a surveyor's abilities, but plants may still occur outside this boundary.

The counting unit is the individual stem or rosette, depending on the species. At very large sub-occurrences, classes are used to quantify number of plants, rather than a census count. Use of classes reduces human error associated with counting large numbers of plants and improves consistency when identifying individual plants of small stature and/or various life stages. Assessments of-sub-occurrence status are solely based on census counts, not statistical analysis. The standard set of statistical tools used by the majority of ecologists are difficult or inappropriate to use when analyzing rare species, either because assumptions such as normality or homoscedasticity do not hold, or because the required sample sizes are impossibly large (Ellison and Agrawal 2005).

Moss and lichen species are more challenging than vascular plant species to quantify due to high stem densities and difficulty in identifying an individual plant. In order to assess the status of moss and lichen species, the area of the sub-occurrence and ocular cover within that area is estimated. Revisits provide a

way to assess presence/absence of previously identified sub-occurrences and changes in the ocular cover provide insight into the overall change of the sub-occurrence. However, percent cover can vary across different months of the year and estimates of cover can vary substantially between observers (Elzinga et al. 1998). For these reasons, quantitative data beyond presence/absence are currently not available. Use of permanent markers and sampling techniques to monitor moss and lichen sub-occurrences is recommended to improve quantitative measurement in future monitoring.

Differences between initial and most recent census counts at each sub-occurrence are used to assess trend, except for Tahoe yellow cress, moss and lichen. In general, a change of greater than 25% was used to decide if a sub-occurrence was increasing or decreasing; however, for very small sub-occurrences (i.e. less than 25 plants), a change of greater than 100% was used. When long-term monitoring plots are established (i.e. six Tahoe draba sub-EO, two Cup Lake draba sub-EO and two long-petaled Lewisia sub-EO), plant counts from monitoring plots were used in lieu of a census count. If the majority of sub-occurrences were increasing or stable, the overall LTBMU trend was considered stable. There is no trend assessment for moss and lichen sub-occurrences—or at a unit-level—due to the lack of quantitative data; instead, only status is discussed, in terms of the percentage of occurrences where the species is present. Trend for Tahoe yellow cress is assessed across the species range as a percentage of occupied sites (Stanton et al. 2015).

4 Forest Service Sensitive Status and Change

The census history of each species—how many known sub-occurrences versus visited sub-occurrences in a given year as well as the total number of known sub-occurrences on LTBMU—for 2002-2015 is summarized in Table 1. In 2015, 43 existing FSS sub-occurrences were revisited and 3 new sub-occurrences were found. In addition, seven TYC sub-occurrences were visited and remapped, but not as part of a species-wide interagency survey. Of the 106 known sub-occurrences, only 43% were monitored in 2015, meaning that there are not current data for many sub-occurrences. The following FSS species exhibited one or more sub-occurrences that appear to be decreasing or were absent at the most recent census: upswept moonwort, scalloped moonwort, Mingan's moonwort, western goblin, Tahoe draba, Cup Lake draba, and Blandow's hump-moss. Status and trend of each species—including year-to year census counts—are discussed in Sections 4.1-4.11.

Table 1. Census history of Forest Service Sensitive species, 2002-2015

Number of sub-occurrences visited during respective year with the total number sub-occurrences on LTBMU in parentheses, as reported in the Forest Service's Natural Resource Information System (NRIS) in 2015; this does not correlate to CNDDB or NatureServe criteria. Total number of sub-occurrences may fluctuate based on discovery of new sub-occurrences, merger of adjacent sub-occurrences, or species misidentification. Such changes are described in detail in the species-specific discussion.

Species (common name)	**2002**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Boechera rigidissima var. *demota* (Galena Creek rockcress)	-	11 (11)	6 (17)	-	-	-	17 (17)	5 (14)	13 (16)	14 (14)	3 (10)[1]	10 (10)	5 (6)
Boechera tiehmii (Tiehm's rockcress)	No known sub-occurrences on LTBMU												
Boechera tularensis (Tulare rockcress)	Known only from herbarium / literary records												
Botrychium ascendens (upswept moonwort)	-	-	-	-	1 (1)	4 (5)	5 (5)	6 (6)	5 (7)	5 (7)	3 (8)	0 (8)	0 (8)
Botrychium crenulatum (scalloped moonwort)	1 (1)	1 (1)	1 (1)	-	-	1 (1)	2 (2)	1 (2)	3 (4)	3 (4)	2 (4)	0 (4)	4 (4)
Botrychium lineare	No known sub-occurrences on LTBMU												

Species (common name)	**2002**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
(slender moonwort)													
Botrychium lunaria (common moonwort)	No known sub-occurrences on LTBMU												
Botrychium minganense (Mingan moonwort)	-	-	1 (1)	-	-	1 (2)	2 (2)	2 (2)	1 (2)	-	0 (2)	0 (2)	2 (2)
Botrychium montanum (western goblin)	-	-	-	1 (1)	1 (1)	-	1 (1)	-	1 (1)	3 (3)	3[2] (3)	0 (3)	1 (3)
Bruchia bolanderi (Bolander's candle-moss)	-	-	-	1 (1)	-	-	5 (7)	5 (7)	3 (7)	2 (8)	2 (8)	5 (9)	6 (13)
Dendrocollybia racemose (branched collybia)	Known only from herbarium / literary records												
Draba asterophora var. asterophora (Tahoe draba)	-	22 (23)	3 (28)	-	-	-	34 (34)	10 (34)	6 (39)	11 (40)	7 (41)	14 (41)	22 (39)
Draba asterophora var. macrocarpa (Cup Lake draba)	-	6 (7)	-	-	-	-	7 (8)	3 (9)	5 (11)	4 (11)	4 (11)	5 (11)	2 (11)
Draba cruciata (Mineral King draba)	Known only from herbarium / literary records												
Erigeron miser (starved daisy)	No known sub-occurrences on LTBMU; suitable habitat only												
Eriogonum luteolum var. *saltuarium* (goldencarpet buckwheat)	No known sub-occurrences on LTBMU; suitable habitat only												
Eriogonum umbellatum var. *torreyanum* (Torrey's buckwheat)	No known sub-occurrences on LTBMU; suitable habitat only												
Helodium blandowii (Blandow's bog-moss)	-	-	-	-	-	-	3 (3)	-	1 (4)	0 (4)	0 (4)	3 (4)	0 (4)
Hulsea brevifolia (short-leaved hulsea)	No known sub-occurrences on LTBMU; suitable habitat only												
Ivesia sericoleuca (Plumas ivesia)	No known sub-occurrences on LTBMU; suitable habitat only												
Lewisia kelloggii ssp. hutchisonii (Hutchinson's lewisia)	No known sub-occurrences on LTBMU; suitable habitat only												
Lewisia kelloggii ssp. kelloggii (Kellogg's lewisia)	No known sub-occurrences on LTBMU; suitable habitat only												
Lewisia longipetala (long-petaled lewisia)	1 (1)	6 (6)	-	1 (6)	-	-	8 (9)	7 (9)	3 (12)	6 (12)	1 (12)	0 (12)	2 (12)
Meesia uliginosa (broad-nerved hump-moss)	-	-	2 (2)	-	-	-	2 (2)	-	2 (2)	0 (2)	0 (2)	2 (2)	0 (2)
Orthotrichum praemorsum (orthotrichum moss)	Known only from herbarium / literary records												
Peltigera gowardii (Goward's water fan)	-	-	-	-	-	1 (1)	-	-	1 (2)	2 (4)	2 (4)	6 (6)	0 (6)
Pinus albicaulis (whitebark pine)	Not monitored at sub-occurrence level												
Rorippa subumbellata (Tahoe yellow cress)	16 (16)	16 (16)	16 (16)	16 (16)	16 (16)	16 (16)	16 (16)	-	29 (34)	34 (34)	0 (34)	34 (34)	7 (34)

As of 2015, the status and trend of FSS species on LTBMU is highly varied and—for some species—relatively uncertain. Encouragingly, it appears that majority of FSS sub-occurrences (63%, 67 sub-EO) are either increasing, present or stable (TABLE 2). Unfortunately, there are still many FSS sub-occurrences (24%, 25 sub-EO) that are either decreasing or absent.

Despite having at least three census events for most sub-occurrences, the overall trend for many FSS species on LTBMU is uncertain. For the four moss and lichen species, no trend could be assessed because monitoring was limited to presence/absence. For the nine vascular species (excluding whitebark pine), one species appears to be increasing (western goblin), four species appear relatively stable (Tahoe draba, Cup Lake draba, long-petaled lewisia, Tahoe yellow cress) and one species appears to be decreasing (upswept moonwort). A trend could not be ascertained for three vascular species (Galena rock cress, scalloped moonwort, Mingan's moonwort) because of conflicting data.

It is worth noting that long-term monitoring has been established for Tahoe draba, Cup Lake draba and long-petaled lewisia—three of the four species that appear stable—but not for any other FSS species on LTBMU. This may suggest that the ability to assess an overall trend is enhanced by the use of permanent plots which can reduce inconsistences among observers in plant count, cover estimation and survey area. For the fourth species (Tahoe yellow cress), long-term surveys using a consistent survey method have been conducted since 2001, though these surveys are not plot-based, may not measure the same spatial extent and are not fully repeatable. Nonetheless, a long-term, consistently collected monitoring record appears to be useful in discerning overall species trend and should be considered an important conservation tool.

Table 2. Summary of the status and trend for Forest Service Sensitive species, 2015

Species	# of LTBMU sub-EOs	New in 2015	Stable as of 2015	Increasing as of 2015	Decreasing as of 2015	Uncertain as of 2015	Overall LTBMU Trend
Boechera rigidissima var. *demota* (Galena Creek rockcress)	6	2	1	2	1	--	Uncertain[1]
Boechera tiehmii (Tiehm's rockcress)	No known occurrences on LTBMU						
Boechera tularensis (Tulare rockcress)	Known only from herbarium / literary records						
Botrychium ascendens (upswept moonwort)	8	0	1	3	4	0	Decreasing
Botrychium crenulatum (scalloped moonwort)	4	0	1	1	1	1	Uncertain
Botrychium lineare (slender moonwort)	No known occurrences on LTBMU						
Botrychium lunaria (common moonwort)	No known occurrences on LTBMU						
Botrychium minganense (Mingan moonwort)	2	0	--	1	1	--	Uncertain
Botrychium montanum (western goblin)	3	0	--	2	1	--	Increasing
Bruchia bolanderi (Bolander's candle-moss)	13	2	--	--	--	--	Uncertain (stable)[2]
Dendrocollybia racemose (branched collybia)	Known only from herbarium / literary records						
Draba asterophora var. asterophora (Tahoe draba)	39	0	15	11	8	5	Stable
Draba asterophora var. macrocarpa (Cup Lake draba)	11	0	2	4	3	2	Stable
Draba cruciata	Known only from herbarium / literary records						

Species	# of LTBMU sub-EOs	New in 2015	Stable as of 2015	Increasing as of 2015	Decreasing as of 2015	Uncertain as of 2015	Overall LTBMU Trend
(Mineral King draba)							
Erigeron miser (starved daisy)	No known occurrences on LTBMU; suitable habitat only						
Eriogonum luteolum var. *saltuarium* (goldencarpet buckwheat)	No known occurrences on LTBMU; suitable habitat only						
Eriogonum umbellatum var. *torreyanum* (Torrey's buckwheat)	No known occurrences on LTBMU; suitable habitat only						
Helodium blandowii (Blandow's bog-moss)	4	0	--	--	--	--	Uncertain (stable)[2]
Hulsea brevifolia (short-leaved hulsea)	No known occurrences on LTBMU; suitable habitat only						
Ivesia sericoleuca (Plumas ivesia)	No known occurrences on LTBMU; suitable habitat only						
Lewisia kelloggii ssp. hutchisonii (Hutchinson's lewisia)	No known occurrences on LTBMU; suitable habitat only						
Lewisia kelloggii ssp. kelloggii (Kellogg's lewisia)	No known occurrences on LTBMU; suitable habitat only						
Lewisia longipetala (long-petaled lewisia)	12	0	5	2	3	2	Stable
Meesia uliginosa (broad-nerved hump-moss)	2	0	--	--	--	--	Uncertain (stable)[2]
Orthotrichum praemorsum (orthotrichum moss)	Known only from herbarium / literary records						
Peltigera gowardii (Goward's water fan)	6	0	--	--	--	--	Uncertain (stable)[2]
Pinus albicaulis (whitebark pine)	Not monitored at occurrence level						
Rorippa subumbellata (Tahoe yellow cress)	34	0	See 2014 TYC interagency data; relatively stable[3]				

[1]While the majority of Galena Creek rockcress are stable or increasing, species misidentification at several locations makes assessing a trend uncertain

[2]Trend could not be assessed for moss or lichen sub-sub-occurrences due to presence/absence data

[3]Site designation for the interagency TYC survey does not follow the same methodology used for other rare plant EO on LTBMU as outlined above. The 2015 TYC Conservation Strategy contains a list and map of known TYC sites.

4.1 *BOECHERA RIGIDISSIMA* (GALENA CREEK ROCKCRESS)

This perennial forb is restricted to Washoe County in Nevada and Placer and Nevada counties in California. There are approximately seven occurrences occurring in the Martis Peak area of California and 26 in the Carson Range in Nevada—though several of these are known misidentifications on NFS lands (California Department of Fish and Wildlife 2015; Nevada Natural Heritage Program 2014). Across the range, an estimated 10,000 individuals are known from private, state and Forest Service land (Nevada Natural Hertiage Program 2010). As for 2015, there are two confirmed occurrences with six sub-occurrences on LTMBU—one near Martis Peak and one near Incline Peak. Galena Creek rockcress had been documented at 18 other locations on LTBMU between 2002-2012; however, these locations—mostly in the southern basin—have been repeatedly revisited and confirmed as misidentifications; at most locations, species key to the *B. platysperma* complex.

Galena Creek rockcress occurs in sandy to rocky soils derived from granitic or volcanic materials, primarily on moderate to steep northerly aspects, often in drainages and in moisture accumulating microsites, meadows edges or in dry openings in conifer forests from 5,900 to 10,200 feet (Baldwin et al. 2012; Nevada Natural Heritage Program 2012).

Galena Creek rockcress is considered globally vulnerable (G3T3Q), critically imperiled in California (S1) and imperiled in Nevada (S2) (NatureServe 2015). According to CNPS, it is regarded as rare in California and elsewhere, although not seriously threatened (California Native Plant Society 2012). In Nevada, it is a NNHP watch list species (Nevada Natural Hertiage Program 2010). The primary threat to this species is recreational activities. Other major threats include forest management activities and road construction and maintenance (Morefield 2002). Based upon census monitoring from 2009-2015, one sub-EO is decreasing, two are increasing, one is stable and two are recently discovered (insufficient data to establish a trend). The overall species trend on LTBMU is uncertain.

Table 3. Monitoring visits to Galena Creek rockcress occurrences, 2009-2015

LTBMU ID	2009	2010	2011	2012	2013	2014	2015	LTBMU Trend
ARRID1a	10		100				300	Increasing
ARRID1g		72	50			10	30	Decreasing
ARRID1i			20	5	10		35	Increasing
ARRID1j							25	New
ARRID2b			250	276			230	Stable
ARRID2c							75	New

4.2 *BOTRYCHIUM* SPP. (MOONWORTS)

Table 4. Monitoring visits to *Botrychium* occurrences, 2002-2015

LTBMU ID	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	LTBMU Trend
BOAS1					4		1	8						Increasing
BOAS2						41	4	15		18				Decreasing
BOAS3a						28[1]	5	1	22	75	100			Increasing
BOAS3b						--[1]	1	0						Decreasing
BOAS3c						29	2	1	19					Decreasing
BOAS4								5	0	2				Decreasing
BOAS5									52	31	74			Stable
BOAS6										33	100			Increasing
BOCR1	3	2	3			2	2			0			2	Stable
BOCR2							900	169	1000				127	Uncertain
BOCR3									47	31	127		62	Decreasing
BOCR4									35	32	41		66	Increasing
BOMI1			2				0						0	Decreasing
BOMI2						3	1	4					42	Increasing
BOMO1				34	11		5	4		0	18		66	Increasing
BOMO2										1	0			Decreasing
BOMO3										2	8			Increasing

[1]BOAS3a,b counted together in 2008, so 2009 data used as baseline

*4.2.1 Botrychium ascendens (*upswept moonwort)

Found throughout western North America, upswept moonwort is known from approximately 19 occurrences in Butte, El Dorado, Lassen, Modoc, Mono, Plumas, Shasta, Tehama and Tulare counties in California and from 3 occurrences in Nevada (California Natural Diversity Database 2012; Nevada Natural Heritage Program 2012). Despite its large range, occurrences generally consist of only a few plants each. On LTBMU, there are six occurrences consisting of eight sub-occurrences.

On LTBMU, this species is strongly associated with seasonally wet areas among incense cedar (*Calocedrus decurrens*) (Engelhardt and Gross 2012). Specific soil requirements are unknown, but pH, calcium and phosphorus may be important components and it generally occurs on organic soil with a sand component (Clines 2009a).

Upswept moonwort is considered globally vulnerable (G3), imperiled (but with no current threats) in California (S2.3) and critically imperiled in Nevada (S1) (NatureServe 2015). While rare in California, it is more common outside the state (California Native Plant Society 2012). Based upon census monitoring from 2007-2015 on LTBMU, four sub-occurrences are decreasing, three are increasing, and one is stable. No surveys for this species occurred in 2015. Overall, the trend for upswept moonwort on LTBMU may be decreasing.

4.2.2 Botrychium crenulatum (scalloped moonwort)

Found throughout western North America, scalloped moonwort is known from approximately 59 occurrences in California in Butte, Colusa, Lassen, Los Angeles, Modoc, Mono, Placer, Plumas, San Bernardino, Shasta, Tehama and Tulare counties and approximately six occurrences in Nevada known from Clark, Elko and Esmeralda counties (California Natural Diversity Database 2012; Nevada Natural Heritage Program 2012). Despite its large range, occurrences generally consist of only a few plants each. On LTBMU, there are four known occurrences, each consisting of only one sub-occurrence.

Suitable habitat for scalloped moonwort includes meadows, bogs, fens, marshes, swamps, and seeps in upper and lower montane coniferous forest from 4,100 to 10,800 feet (California Native Plant Society 2012). Specific soil requirements are unknown, but pH, calcium and phosphorus may be important components (Clines 2009b).

Scalloped moonwort is considered globally vulnerable (G3), imperiled in California (S2.2) and critically imperiled in Nevada (S1) (NatureServe 2015). Census monitoring from 2009-2015 suggests that one sub-occurrence is decreasing, one is stable, one is increasing and there is one for which a trend cannot be determined (despite four census events). Therefore, the overall trend for scalloped moonwort on LTBMU is uncertain.

4.2.3 Botrychium minganense (Mingan moonwort)

This perennial fern-like plant has a broad distribution in northern and western North America consisting of approximately 300 global occurrences. In California, there are approximately 28 occurrences known from Sequoia Kings National Park and Lassen, Plumas, Modoc, San Bernardino and Inyo National forests (California Natural Diversity Database 2012). As of 2015, there are two known occurrences on LTBMU, each consisting of only one sub-occurrence.

Suitable habitat for Mingan moonwort includes bogs, fens, meadows or riparian corridors in upper and lower montane coniferous forests from 5,100 to 10,300 feet (California Native Plant Society 2012; California Natural Diversity Database 2012).

Due to its wide geographic range and a trend of relatively stability, common moonwort is considered relatively secure globally (G4G5), though it is considered vulnerable in California (S2) (NatureServe 2015). Census monitoring from 2002-2015 at both LTBMU sub-occurrences suggests one is decreasing while the other is increasing. So, the overall trend for Mingan moonwort on LTBMU is uncertain.

4.2.4 Botrychium montanum (western goblin)

This perennial fern-like plant has a broad distribution across Alaska, California, Oregon, Washington, Idaho and Montana. In California, there are approximately 22 known sub-occurrences from Lassen, Modoc, Sierra and Plumas National Forests ranging from Butte, El Dorado, Fresno, Lassen, Modoc,

Plumas, Shasta, Sierra and Tehama counties (California Natural Diversity Database 2012). As of 2015, there are three known sub-occurrences—each consisting of one sub-sub-occurrence each—on LTBMU in seeps and riparian areas west of Meeks and Rubicon Bays.

Suitable habitat for western goblin includes occurs in meadows, seeps and riparian corridors within upper and lower montane coniferous forests from 3,200 to 9,000 feet (California Native Plant Society 2012). On LTBMU, this species is strongly associated wet areas among incense cedar (*Calocedrus decurrens*). Specific soil requirements are unknown, but pH, calcium and phosphorus may be important components (Clines 2009a).

This species is considered vulnerable both globally (G3) and in California (S2) (NatureServe 2015). Dispersed recreation—especially off-trail hiking, biking, and equestrian recreation—represent the primary threat to western goblin on LTBMU. Census monitoring at all three LTBMU occurrences from 2006-2015 suggests that two occurrences are increasing, while one is decreasing. Overall, the trend for western goblin on LTBMU appears be increasing.

4.3 *BRUCHIA BOLANDERI* (BOLANDER'S CANDLE-MOSS)

This ephemeral bryophyte has a broad range in western North America, occurring in Oregon, California, Nevada and Utah (California Native Plant Society 2012). There are approximately 30 occurrences known from Forest Service and National Park land in California in El Dorado, Fresno, Madera, Modoc, Mariposa, Nevada, Plumas, Sierra, Tehama, Tulare, Tuolumne and Nevada counties (California Natural Diversity Database 2012). As of 2015, there are eight known occurrences, consisting of ten sub-occurrence on LTBMU.

Bolander's candle-moss occurs in disturbed areas and openings on the edges of meadows and streams in lower to upper montane forests from 5,500 to 9,200 feet (California Native Plant Society 2012). The species is opportunistic, taking advantage of moderately disturbed sites on organic soil with minimal competition from other vegetation (Harpel 2009). Because it colonizes bare soil in wetter habitats, fire would typically not carry well within its habitat (Harpel 2009).

Bolander's candle-moss is considered vulnerable both globally (G3) and in California (S3), and critically imperiled in Nevada (S1) (NatureServe 2015). Threats include trampling of stream banks and any other activity that would increase erosion or alter hydrology (Harpel 2009). From 2006-2015, species monitoring on LTBMU includes only presence/absence data, making it difficult to determine a trend for Bolander's candle moss on LTBMU.

Table 5. Monitoring visits to Bolander's candle-moss occurrences, 2002-2015

LTBMU ID	2006	2009	2010	2011	2012	2013	2014	2015	LTBMU Status[1]
BRBO1	P	P	A			P			Present
BRBO2		P		P					Present
BRBO3a		P	P				P	P	Present
BRBO3b1		P	P				A	A	Absent
BROBO3b2							P	P	Present
BRBO4		P		P					Present
BRBO5			P		A			P	Absent
BRBO6			P	P					Present
BRBO7					P	P			Present
BRBO8							P	P	Present

[1]Trend can be difficult to determine for bryophyte and lichen species due to presence (P) / absence (A) only data; only most recent status reported

4.4 *DRABA ASTEROPHORA* VAR. *ASTEROPHORA* (LAKE TAHOE DRABA)

This perennial forb is restricted to alpine talus slopes and occurs in a discontinuous distribution from Mt. Rose in Washoe County, Nevada to Mt. Gibbs near Tioga Pass in Yosemite, California (Schlesinger and Holst 2000) . There are approximately 20 occurrences known from NFS and state lands on Mt. Rose in Nevada, and Heavenly Ski Resort, Freel Peak, Job's Sister and Mt. Gibbs in California(California Natural Diversity Database 2012). As of 2015, there are four known occurrences, consisting of 39 sub-occurrence on LTBMU; LTBMU manages approximately 75% of Tahoe draba, rangewide.

Tahoe draba occurs in rock crevices and open granite or volcanic, north or east facing talus slopes near the Sierra Crest between 8,000 and 11,500 feet (California Natural Diversity Database 2012). This species is found in areas of sparse cover and is often associated with other pin-cushion plants. It occurs primarily on soils of decomposed granite; however, on Mt. Rose and Mt. Gibbs, it occurs on volcanic and metamorphic talus (Schlesinger and Holst 2000).

Tahoe draba is considered imperiled both globally (G2T2) and in the state of California (S2), and is critically imperiled in Nevada (S1S2) (California Native Plant Society 2012; NatureServe 2015). The primary threat to this species is ski area development and maintenance (California Native Plant Society 2012; Putnam 2013); several sub-occurrences have already been impacted by ski run development and ski lift installation at Heavenly Mountain Resort (S. Gross, pers.comm.). Other threats include unmanaged recreation (in particular, off trail hiking and snowmobile use near Freel Peak and Job's Sister), hiking trail construction and use (especially near Mt. Rose), equestrian use, and utility line construction and maintenance. With its range situated on the Sierra Crest, Tahoe draba is also at risk of environmental or vegetation shifts associated with climate change.

Data from 39 sub-occurrences monitored from 2002-2015 indicate that the trend for the species on LTBMU is relatively stable (11—increasing, 15—stable; 8—decreasing, 5—uncertain) (TABLE 6). In 2010, long-term demographic monitoring was initiated at three occurrences (seven sub-EO) on LTBMU (Engelhardt and Gross 2011a). Plots were remeasured in 2011, 2012 & 2015, but data have not yet been analyzed. Preliminary analysis of the total number of plants in each plot seems to agree with census data that the overall trend on LTBMU is stable (FIGURE 1).

Table 6. Monitoring visits to Tahoe draba occurrences 2004-2015

LTBMU EO	2004	2005	2009	2010	2011	2012	2013	2014	2015	LTBMU Trend
DRASA1a (1c, 1q)	1000+		1000+	M(93)	M(114)	M(100)			M(102)	Stable[1]
DRASA1b	1000+		1000+	M(100)	M(120)	M(111)		1000+	3000 / M(122)	Stable
DRASA1d	1000+		1000+	M(43)	M(53)	M(48)			M(53)	Stable
DRASA1e	375*		375*							Stable
DRASA1f	4		5						5000	Uncertain[2]
DRASA1g	175*		175*							Stable
DRASA1h	750*		750*							Stable
DRASA1i	116		X	6						Uncertain[3]
DRASA1j	1000+		1000+	M(144)	M(172)	M(158)			1000+ / M(139)	Stable
DRASA 1k	375*		375*							Stable
DRASA 1l			90			52				Decreasing
DRASA 1m	X		375*			1200				Increasing
DRASA 1n					224	168				Decreasing
DRASA 1o					175[1]	375[1]				Increasing
DRASA 1p					300+					Uncertain
DRASA 2a	375*		375*					610	1018	Increasing
DRASA 2b	750*		375*	780 / M(116)	M(172)	M(178)		800	891 / M(183)	Increasing

LTBMU EO	2004	2005	2009	2010	2011	2012	2013	2014	2015	LTBMU Trend
DRASA 2c	375*		375*					1150	2151	Uncertain[2]
DRASA 2d	175*		175*					200	160	Decreasing
DRASA 2e	750[1]		750[1]					500		Stable
DRASA 2f	1000+		1000+	M(131)	M(170)	M(169)		5000	M(233)	Increasing[2]
DRASA 2g			375*			375*	417	400	215	Decreasing
DRASA 2h			45			1350*		1800	1015	Decreasing
DRASA 2i		225	500+					5000		Uncertain[2]
DRASA 2j		275	375*					1200	1000	Uncertain[2]
DRASA 2k		2	1				2	4	2	Stable
DRASA 2n			7			0	28	17	21	Stable
DRASA 2o			33			46		46	50	Increasing
DRASA 2p							150	425		Increasing[2]
DRASA 3a	750*		750*						1000	Increasing
DRASA 3b	750*		1000+	M(168)	M(191)	M(199)			M(161)	Stable
DRASA 3c	750*		750*						1000	Increasing
DRASA 3d	11		13						10	Stable
DRASA 3e	175*		175*						350	Increasing
DRASA 3f			175*			417	480			Increasing
DRASA 3g		X	9	30					6	Stable
DRASA 3h		X	30	0[3]	31				20	Stable
DRASA3i						4	0			Decreasing
DRASA 4					250+		300+			Stable

X—indicates that the sub-sub-occurrence was known or visited but a census was not completed.
M(##)—indicates long-term monitor plot plant count; number in parentheses are the number of plants in plot—not full census of sub-EO.
*Plant count was estimated as 100-250, 250-499, 500-999, or 1200-1500; mid-value presented.
[1]In 2015, sub-EO DRASA1b, 1q were combined into DRASA1a because surveys of intervening suitable habitat revealed plants connecting these areas.
[2]Increase is likely due to increased survey effort, rather than actual increase
[3]DRASA 1i occurs in a very steep chute that is dangerous to ascend. Six plants were observed at the base of the chute in 2010 and plants were visible continuing upward; therefore DRASA1i is considered stable.

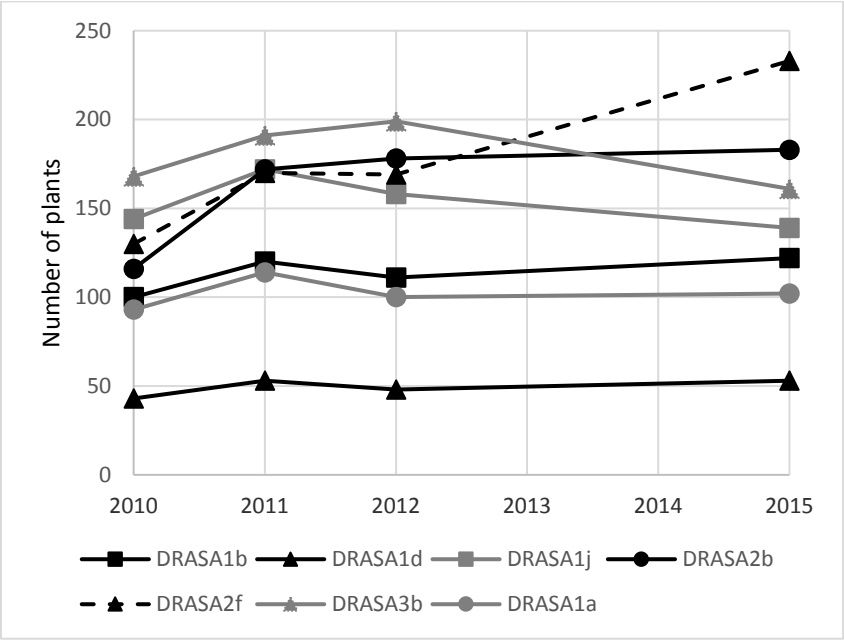

Figure 1. Total number of Tahoe draba plants in long-term monitoring plots, 2009-2015

4.5 *DRABA ASTEROPHORA* VAR. *MACROCARPA* (CUP LAKE DRABA)

This perennial forb is restricted to alpine talus slopes near Saucer Lake, Cup Lake and Ralston Peak in El Dorado County, California (California Natural Diversity Database 2012). This species differs from Tahoe draba (*Draba asterophora* var. *asterophora)* by its slightly larger petals, styles, and seed pods (Baad 1979; Baldwin et al. 2012). Rangewide, there is a single occurrence with twelve sub-occurrences; eleven sub-occurrences on LTBMU and one on El Dorado National Forest at Cup Lake. LTBMU manages over 90% of Cup Lake draba, rangewide (Engelhardt and Gross 2011a).

This species occurs above 8,200 feet in subalpine coniferous forests on steep northerly facing talus and boulder slopes or chutes composed of decomposed granitic soils (NatureServe 2015; Schlesinger and Holst 2000).

Cup Lake draba is considered globally imperiled (G2T1)and critically imperiled in California (S1) (California Native Plant Society 2012; NatureServe 2015). The primary threat to this species is trampling from off trail hiking leading to Cup Lake (California Native Plant Society 2012). Ski resort development and maintenance does not pose a threat to this variety, as it occurs in Desolation Wilderness and remote areas of El Dorado National Forest. With its range situated on the Sierra Crest, Cup Lake draba is at risk of environmental or vegetation shifts associated with climate change.

Data from 11 sub-occurrences monitored from 2002-2015 indicate that four are increasing, two are stable, three are decreasing and two are uncertain (TABLE 7). In 2010, long-term demographic monitoring was initiated at two sub-occurrences on LTBMU (Engelhardt and Gross 2011a). Plots were remeasured in 2011, 2012 and 2015, but data have not yet been analyzed(Engelhardt and Gross 2011a). Preliminary analysis of the total number of plants in each plot are somewhat contradictory, with one sub-occurrence increasing and the other decreasing (FIGURE 2). Overall, the trend on LTBMU appears to be relatively stable, but with some uncertainty.

Table 7. Monitoring visits to Cup Lake draba occurrences, 2004-2015

LTBMU ID	2004	2009	2010	2011	2012	2013	2014	2015	LTBMU Trend[1]
DRASM 1a	43	0	0	250	180		160		decreasing
DRASM 1b	1000+	175*	1000+ / M(130)	1000+ / M(143)	1000+ / M(124)			M(108)	decreasing
DRASM 1c	375*	375*							stable
DRASM 1d	12	45					45		increasing
DRASM 1e	375*	750*	M(124)	M(183)	M(188)			M(188)	increasing
DRASM 1f	X	X			X	18	18		uncertain[1]
DRASM 1g	X	0	0	0					decreasing
DRASM 1h				750*	550*				uncertain
DRASM 1i				3500*	3500*				stable
DRASM 1j						290	1000		increasing
DRASM 1k		375*			697	558	700		increasing[1]

X—indicates that sub-occurrence was visited but a census was not completed.
M(##)—indicates long-term monitor plot plant count; number in parentheses are the number of plants in plot—not full census of sub-EO.
*Plant count was estimated as 100-250, 250-499, 500-600, 500-999, or 3000-4000; mid-value presented.
[1]This sub-occurrence was split into DRASA1f and DRASA1k in 2013. Previous plant counts for DRASA1f were assigned to larger, separate DRASA1k

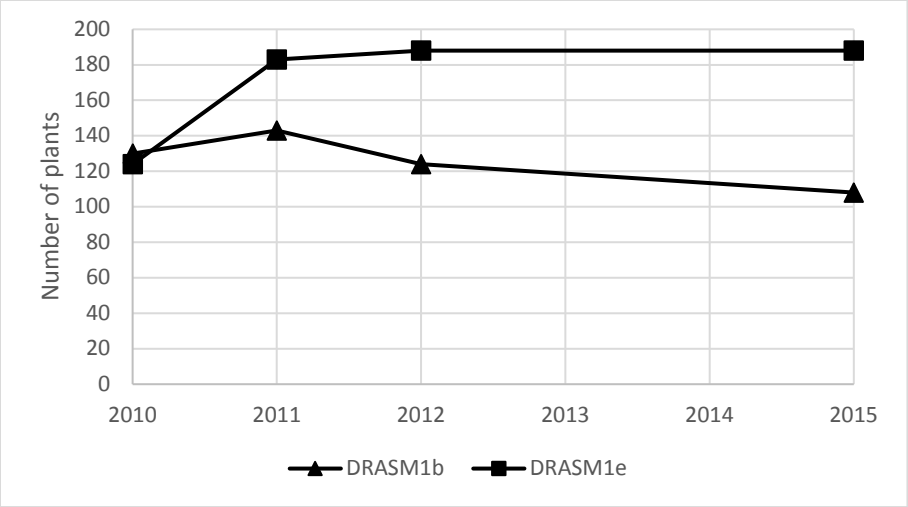

Figure 2. Total number of Cup Lake draba plants in long-term monitoring plots, 2010-2015

4.6 *HELODIUM BLANDOWII* (BLANDOW'S BOG MOSS)

This bryophyte has broad distribution in North America occurring in meadows, seeps and fens across the United States and Canada (NatureServe 2015). In California, Blandow's bog moss is known from 12 occurrences: two in Kings Canyon National Park, three on Inyo National Forest, two on Humboldt-Toiyabe National Forest, two on Klamath National Forest, and one on Stanislaus National Forest (California Natural Diversity Database 2012). As of 2015, there are two known occurrences on LTBMU—one in the Grass Lake Research Natural Area, and one in a fen near Armstrong Pass—consisting of three sub-occurrences.

Suitable habitat for Blandow's bog moss includes wet montane meadows, fens, and seeps, especially under willow in areas of leaf litter, in subalpine coniferous forests and near alpine lakes (Flowers 1973). In the Sierra Nevada, the elevation and habitat range appears to be limited to fens from 6,100 to 8,900 feet ((California Native Plant Society 2012; California Natural Diversity Database 2012). Fens are among the most sensitive plant communities identified during ecological assessments of the Sierra Nevada (Millar 1996; USDA Forest Service 2004a).

While vulnerable in California (S2), Blandow's bog moss is considered relatively secure globally (G4)(NatureServe 2015). The primary threat to this species is hydrologic alterations to fens from activities such as irrigation ditching, grazing, road and trail construction, or dispersed camping (California Native Plant Society 2012). Reduced snowpack as a result of climate change may reduce groundwater input into fens where this species occurs (Drexler et al. 2011). Species monitoring from 2002-2014 on LTBMU includes only presence/absence data, making it difficult to determine a trend for Blandow's bog moss on LTBMU (TABLE 8). No sub-occurrences were monitoring in 2015.

Table 8. Monitoring visits to Blandow's bog moss occurrences, 2009-2015

LTBMU ID	2009	2010	2011	2012	2013	2014	2015	LTBMU Status[1]
HEBL 1	P		P			P		Present
HEBL 2a	P					P		Present
HEBL 2b	P					A		Absent

[1]Trend can be difficult to determine for bryophyte and lichen species due to presence (P) / absence (A) only data; only most recent status reported

4.7 *LEWISIA LONGIPETALA* (LONG-PETALED LEWISIA)

This perennial forb is restricted to alpine snowfields in El Dorado, Placer and Nevada counties in California (California Native Plant Society 2012). There are approximately 16 occurrences known from LTBMU, El Dorado and Tahoe National Forests (Engelhardt and Gross 2011b). As of 2015, there are five known occurrences on LTBMU, consisting of twelve sub-occurrences.

Long-petaled lewisia is endemic to alpine snowfield communities along the crest of the northern Sierra Nevada between elevations of 8,000 to 12,000 feet (Engelhardt and Gross 2011b; Halford and Nowak 1996). It grows in moist, rocky habitats directly below persistent snowfields, typically on north-facing and leeward slopes where snow accumulation is greatest. This species usually occurs on gentle gravelly or boulder strewn slopes but are also found in the crevices of large rock slabs, generally with soils derived from granitic or basaltic parent materials (Engelhardt and Gross 2011b).

Long-petaled lewisia is considered imperiled both globally (G2) and in California (S2.2)(NatureServe 2015). Most occurrences are known from wilderness areas where management activities present a relatively low threat; however, trail use may still degrade habitat (Engelhardt and Gross 2011b). Because it is strongly associated with persistent snowfields, long-petaled lewisia is likely highly vulnerable to climate change (Halford and Nowak 1996). Climate change models predict a decrease in the amount and persistence of snow and an increase in rain in the Sierra Nevada, which could substantially alter or reduce suitable habitat (Coats 2010; Mastrandrea and Luers 2012).

From census monitoring data collected from 2002-2015 at all 12 LTBMU sub-occurrences, it appears that five sub-occurrences are stable, two are increasing, three are decreasing and two are uncertain (TABLE 9). Long-term demographic monitoring was initiated in 2009 and 2010 at two occurrences on LTBMU (Engelhardt and Gross 2011b). Plots were remeasured in 2012 and 2015, but data have not yet been analyzed. Preliminary analysis of the total number of plants in the long-term monitoring plots from 2009-2015 appears to indicate that one sub-occurrence is decreasing while the other appears relatively stable (FIGURE 3). Overall, the trend on LTBMU appears stable.

Table 9. Monitoring visits to long-petaled lewisia occurrences, 2002-2015

LTBMU ID	2002	2004	2006	2009	2010	2011	2012	2013	2014	2015	LTBMU Trend
LELO1a	6000	4450	-	7860 / M(340)	M(394)	-	M(463)			M(376)	stable
LELO1b	-	360	-	4	2	-	4				decreasing
LELO1c	-	124	-	1	33	-	30				decreasing
LELO1d	-	1	-	1	12	-	-				increasing
LELO 2a	9	472	-	86	331	-	-				uncertain
LELO2b	-	-	-	800	1450	100	175				uncertain
LELO3a	-	1067	-	750	M(153)	-	M(136)			M(80)	decreasing
LELO3b	-	-	150	201	-	-	-				stable
LELO4a	-	-	-	-	-	1	3				stable
LELO4b	-	-	-	-	-	40	175				increasing
LELO4c	-	-	-	-	-	100	100				stable
LELO5	-	-	-	-	-	-	485	500			stable

M(##)—indicates long-term monitor plot plant count; number in parentheses are the number of plants in plot—not full census of sub-EO.

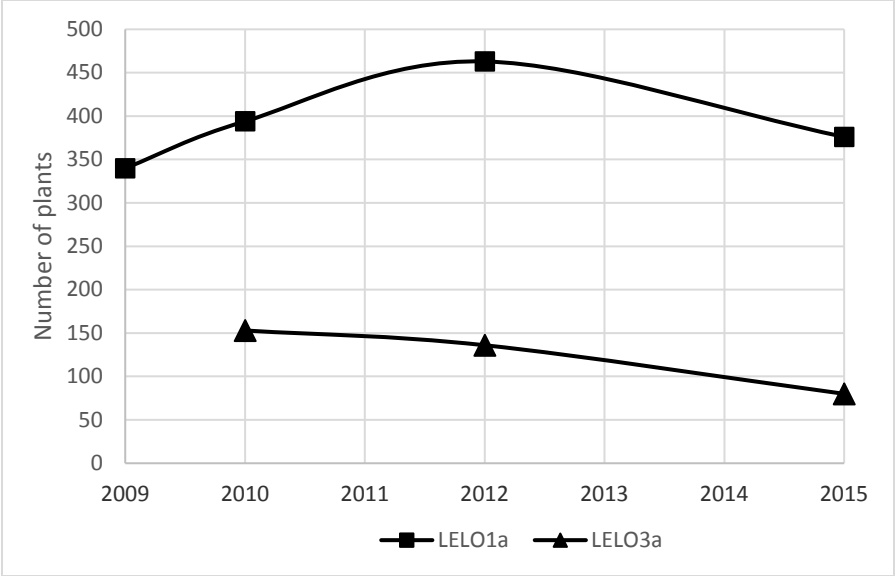

Figure 3. Total number of long-petaled lewisia plants in long-term monitoring plots, 2009-2015

4.8 *MEESIA ULIGINOSA* (BROAD-NERVED HUMP-MOSS)

This circumboreal moss has a broad distribution occurring in North and South America, the Himalayas and Antarctica (Dillingham 2005). There are approximately 31 occurrences in California known from Sequoia-Kings Canyon National Park and Plumas, Sequoia, Sierra and Tahoe National Forests. There are two known occurrences on LTBMU—in the Upper Truckee Meadow area and the Angora fen—consisting of one sub-occurrence each.

This moss occurs in fens, peaty soil banks, seeps, meadows, and rock fissures upon exposed, damp organic soil within upper montane to subalpine coniferous forest from 4,200 to 9,200 feet (California Native Plant Society 2012; Harpel 2003). It prefers to live upon calcareous substrates, usually in alpine or arctic regions, but also occurs in rich fens at lower elevations (Dillingham 2005).

While vulnerable in California (S2), broad-nerved hump-moss is considered relatively secure globally (California Native Plant Society 2012; NatureServe 2015). The primary threat to broad-nerved hump-moss is hydrologic alterations from activities such as irrigation ditching, grazing, road and trail construction, or dispersed camping (California Native Plant Society 2012). Fens are among the most sensitive plant communities identified during ecological assessments of the Sierra Nevada (Millar 1996; USDA Forest Service 2004a). On LTBMU, monitoring at both occurrences from 2005-2015 includes only presence/absence data, making it difficult to determine a trend (TABLE 10). No occurrences were visited in 2015.

Table 10. Monitoring visits to broad-nerved hump-moss sub-occurrences, 2005-2015

LTBMU ID	2005	2009	2010	2011	2012	2013	2014	2015	LTBMU Status[1]
MEUL 1	P	P		P			P		Present
MEUL 2	P	P		P			P		Present

[1]Trend can be difficult to determine for bryophyte and lichen species due to presence (P) / absence (A) only data; only most recent status reported

4.9 *PELTIGERA GOWARDII* (GOWARD'S WATER FAN)

This aquatic foliose lichen has a broad distribution in cold unpolluted streams of California, Oregon, Washington, Idaho and Alaska (Peterson 2010). Previously, this species was believed to be synonymous with *Peltigera hydrothyria* which has a distribution in the mountainous areas of the eastern United States. Now that it has been segregated from that species, the number of known occurrences has been reduced by virtue of a reduced range (Lendemer and O'Brien 2011).There are approximately 26 occurrences known in California on Eldorado, Tahoe, Plumas, Sequoia, Shasta-Trinity, Lassen, Klamath, Six Rivers, Sierra, Inyo and Stanislaus national forests (California Department of Fish and Wildlife 2015). On LTBMU, there are three known occurrences, consisting of five sub-occurrences.

Goward's water fan occurs in unpolluted, spring-fed, fast moving, perennial streams with little seasonal flux in mixed conifer forests (Peterson 2010). It grows on rocks, and occasionally wood where it is submerged or within the splash zone of waterfalls throughout most of the year (Peterson 2010). It has been documented in a narrow stream temperature range: from 5 to 15 degrees Celsius.

Due to its widespread distribution, Goward's water fan is considered relatively secure globally (NatureServe 2015). It is considered somewhat vulnerable in California (S3) due to its narrow habitat requirements and relative rarity (California Native Plant Society 2012). The primary threat to this species is any change in stream conditions including water quality, chemistry, temperature, light regime, level, opacity or sediment load, stream bank stability, or altering of microclimate conditions (Peterson 2010). Activities that may contribute to this risk include building and decommissioning roads, run off from fertilizers, water transfer projects that reduce cold water flows in later summer and increase sedimentation, and management activities that change surrounding vegetation cover. On LTBMU, monitoring at all three occurrences from 2008-2015 includes only presence/absence data, making it difficult to determine a trend (TABLE 11). No occurrences were visited in 2015.

Table 11. Monitoring visits to Goward's water fan occurrences, 2008-2015

LTBMU ID	2008	2009	2010	2011	2012	2013	2014	2015	LTBMU Status[1]
PEGO1a	P								Present
PEGO1b				P					Present
PEGO1c							P		Present
PEGO2a					P	P	P		Present
PEGO2b					P	P	P		Present
PEGO3							P		Present

[1]Trend can be difficult to determine for bryophyte and lichen species due to presence (P) / absence (A) only data; only most recent status reported

4.10 PINUS ALBICAULIS (WHITEBARK PINE)

Whitebark pine is not currently monitored systematically on LTBMU, but a summary of its status and trend are included.

This 5-needle white pine has broad distribution at high elevation, subalpine, and timberline zones in California, Idaho, Nevada, Oregon, Washington, Wyoming, Alberta, and British Colombia (NatureServe 2015). In California, whitebark pine has been recorded on National Forest System lands in Six Rivers, Klamath, Modoc, Shasta-Trinity, Lassen, Tahoe, Eldorado, Lake Tahoe Basin Management Unit, Stanislaus, Sierra, Inyo, and Sequoia National Forests (Coppoletta 2012). While the species has a broad geographic range, precise information regarding the abundance and distribution of stands is limited.

Pinus albicaulis occurs on slopes and ridges near timberline, often with cold windswept exposures, resulting in geographically isolated stands (Arno and Hoff 1989). In the Sierra Nevada and Cascade

Ranges of California, whitebark pine often occur as pure or nearly pure stands in the subalpine zone, where it regularly defines the upper tree line and often forms krummholz cushions. This species generally occurs on cryochrept soils—cold-climate soils lacking development—that are moderately to poorly draining, nutrient poor and from granitic or basaltic origins (Fryer 2002).

Mortality data collected in multiple studies throughout its range suggest that whitebark pine is in range-wide decline (Keane et al. 2012; US Fish and Wildlife Service 2011b). The primary threat to whitebark pine across its range is a synergistic combination of climate change, white pine blister rust (WPBR), periodic mountain pine beetle (MPB) outbreaks and fire exclusion (Keane et al. 2012; Millar et al. 2004; US Fish and Wildlife Service 2011b). When compared to other parts of the range, such as the Rockies, California has experienced relatively low mortality of whitebark pine, potentially due to the lower incidence of WPBR (Dunlap 2010; Millar et al. 2012); however, recent monitoring and research results suggest that this may be changing (Forest Health Protection 2012; Gibson et al. 2008). On LTBMU, one-time demographic data from eight stands indicates relative stability of the whitebark pine population, except near Mt. Rose where stands may be in decline ((Maloney et al. 2012)).

Whitebark pine is a candidate for federal listing under the Endangered Species Act (ESA) (US Fish and Wildlife Service 2011b). Candidate species receive no statutory protection under ESA (US Fish and Wildlife Service 2011a); candidate management is dictated by the direction of the agency upon which the species occurs. Whitebark pine was added to the Regional Forester's Sensitive Species List in 2013 (USDA Forest Service 2013).

While there are many stands of whitebark pine known on LTBMU—extending from Mt. Rose in the north to Desolation Wilderness in the south, and some west shore peaks—there is a high level of uncertainty regarding the abundance and distribution of these stands. Currently, the best available spatial data for estimating LTBMU's whitebark pine abundance and distribution is a combination of the Potential Natural Vegetation (PNV) data in the Terrestrial Ecological Unit Inventory (TEUI) and the Region 5's Existing Vegetation data (EVeg) (USDA Forest Service 2009). Estimates of the abundance of whitebark pine on LTBMU range from approximately 1,500 acres to over 24,000 acres (TABLE 12). Due to the minimum stand size analyzed to produce these datasets, they do not capture scattered trees and small stands, but it is still considered the best available data on distribution of whitebark pine on LTBMU.

4.10.1 Estimate of LTBMU Extent and Distribution

Table 12. Summary of acreage mapped as potential whitebark pine

Data source	Stand type	Acres
EVeg	Whitebark pine—Dominant	1,518
EVeg + TEUI overlap	Whitebark pine—Dominant	5,079
TEUI	Whitebark pine—Dominant	9,877
EVeg	Whitebark pine—Potential	17,791
EVeg + TEUI	Whitebark pine—Potential	24,387

Methodology outlined in APPENDIX D.

4.11 RORIPPA SUBUMBELLATA (TAHOE YELLOW CRESS)

This perennial forb is endemic to the shores of Lake Tahoe. Rather than using the CNDDB EO separation standard of one-quarter mile, TYC is better described as a single population with several sites that may or may not be occupied annually based on lake levels (Pavlik et al. 2002). Currently, there are 55 known Tahoe yellow cress (TYC) sites, though five are considered extirpated; there are 13 sites on LTBMU (site at Zephyr Cove partially on private), representing approximately 24% of known occurrences (Stanton et al. 2015).

TYC occurs in moist backshore beach depressions within a very narrow elevation range—6,233-6230 feet (Pavlik et al. 2002). It occurs on sandy or silty soils comprised of decomposed granite (US Fish and Wildlife Service 2012). TYC site occupancy fluctuates with lake water levels, which are related to long-term climate trends and regulation of Tahoe's dam at Tahoe City (Pavlik et al. 2002). During high water years, the number of occupied sites typically decreases, whereas in low water years the number increases (Pavlik et al. 2002).

TYC was a candidate for federal listing under the Endangered Species Act from 1985 until 2015, when the US Fish and Wildlife Service found that listing was not warranted (80 F.R. 60834 2015). It is a Tahoe Regional Planning Agency (TRPA) sensitive species, considered endangered by the State of California and threatened by the State of Nevada. The primary threats to TYC are anthropogenic activities in the shore zone—including dispersed and developed recreation, construction and maintenance of marinas, piers, boat ramps, and other recreational facilities—especially when the lake level is high and there are fewer occupied sites (Pavlik et al. 2002).

Ad-hoc monitoring of Tahoe yellow cress has been occurring since 1979, but in 2001, a comprehensive monitoring program for TYC was initiated (Stanton et al. 2015). Surveys are conducted every year at high water levels and every other year when there are consecutive low water years. Surveys occur in September to capture impacts from summer recreation. Seven sub-occurrences were visited in 2015, but not as a part of the interagency range-wide survey (TABLE 1). In the last interagency survey (2014), there were 32 sites occupied of the 50 sites surveyed (5 of the 55 are considered historic and not surveyed) (TABLE 13). This represents 78% site occupancy, which is within the historic range of variation for low water years(Stanton et al. 2015). Despite fluctuations in site occupancy associated with lake levels, the long-term trend for Tahoe yellow cress appears relatively stable (Stanton et al. 2015). A range-wide survey is planned for 2016.

Table 13. Census data for *R. subumbellata* sites on NFS lands from recent interagency surveys, 20122014

Site Name	Owner	2012	2014
Lake Elevation (ft., LTD)		6226'	6223'
Kaspian Campground	USFS	0	3
Meeks Bay	USFS	3	0
Tallac Enclosure	USFS	344	247
Tallac Creek	USFS	4	221
Baldwin Beach	USFS	73	316
Taylor Creek	USFS	916	2111
Kiva Beach/Valhalla	USFS	0	62
Pope Beach	USFS	0	12
Nevada Beach	USFS	140	62
Roundhill	USFS	0	12
Zephyr Cove	Private/USFS	20	137
Skunk Harbor	USFS	0	0
Secret Harbor	USFS	0	0
Chimney Rock	USFS	0	0

Data excepted from 2015 TYC Conservation Strategy (Stanton et al. 2015)

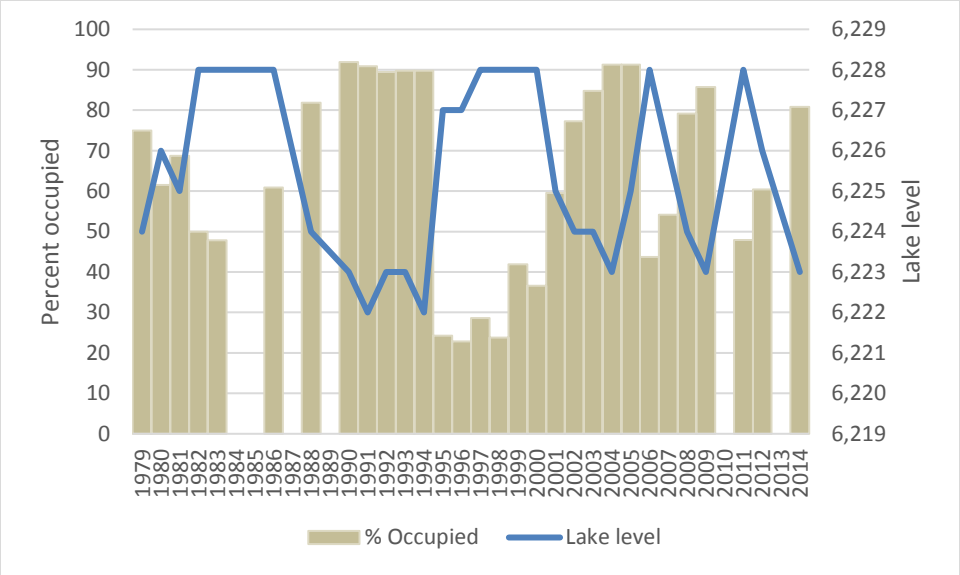

Figure 4. Percent occupied TYC sites surveyed from 1979 to 2014 and corresponding surface elevation of Lake Tahoe
Lake level is measured in September at USGS Tahoe City gage 103370000. 50 sites were surveyed. No surveys were conducted in six years (represented by an absent bar). Figure excerpted from 2015 TYC Conservation Strategy ((Stanton et al. 2015))

5 Watch List Status and Trend

The census history of each LTBMU watch list (WL) species for 2007-2015 is summarized in Table 14. The status and trend of each species is summarized in Table 15. In 2015, no existing WL sub-occurrences were revisited, but six new sub-occurrence were found. Of the 53 known sub-occurrences, only 11% were monitored in 2015, meaning that there are not current data for the vast majority of sub-occurrences (Table 14). As of 2015, the status and trend of WL species on LTBMU is highly varied and—for most species—relatively uncertain (Table 15). Status and trend of each species—including year-to year census counts—are discussed in Sections 5.1-5.5.

Table 14. Census history of LTBMU watch list species, 2007-2015
Number of sub-occurrences visited during respective year with the total number sub-occurrences on LTBMU in parentheses, as reported in the Forest Service's Natural Resource Information System (NRIS) in 2015; this does not correlate to CNDDB or NatureServe criteria. Total number of sub-occurrences may fluctuate based on discovery of new sub-occurrences, merger of adjacent sub-occurrences, or species misidentification. Such changes are described in detail in the species-specific discussion.

Species (Common name)	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Astragalus austiniae (Austin's milkvetch)	-	-	-	-	-	-	-	-	6 (6)
Boechera rectissima (Arabis rectissima var. *simulans)* (Washoe tall rockcress)	-	-	-	-	-	1 (5)	1 (5)	0 (5)	0 (2)
Carex davyi (Davy's sedge)	Known only from herbarium / literary records								
Chaenactis douglasii var. alpina (alpine dusty madiens)	-	-	-	-	5 (5)	4 (9)	2 (11)	0 (11)	0 (11)
Claytonia megarhiza Fell fields claytonia	-	-	1 (1)	0 (1)	1 (2)	0 (2)	0 (3)	0 (3)	0 (3)
Cryptantha crymophila (subalpine cryptantha)	No known occurrences on LTBMU; suitable habitat only								
Epilobium palustre (marsh willowherb)	Known only from herbarium / literary records								

Species (Common name)	2007	2008	2009	2010	2011	2012	2013	2014	2015
Meesia longiseta (meesia moss)	No known occurrences on LTBMU; suitable habitat only								
Myurella julacea (myurella moss)	No known occurrences on LTBMU; suitable habitat only								
Orthotrichum holzingeri (Holzinger's orthotrichum moss)	No known occurrences on LTBMU; suitable habitat only								
Orthotrichum spjutii (Spjut's orthotrichum moss)	No known occurrences on LTBMU; suitable habitat only								
Pohlia tundrae (tundra pohlia moss)	Known only from herbarium / literary records								
Sphagnum spp. (sphagnum moss)	2 (2)	4 (6)	14 (14)	14 (20)	10 (24)	1 (26)	0 (26)	2 (27)	0 (27)
Tomentypnum nitens (tomentypnum moss)	No known occurrences on LTBMU; suitable habitat only								

Table 15. Summary of status and trend for LTBMU watch list species, 2015

Species (Common Name)	# of LTBMU sub-EOs	New in 2015	Stable as of 2015	Increasing as of 2015	Decreasing as of 2015	Uncertain as of 2015	Overall LTBMU Trend
Astragalus austiniae (Austin's milkvetch)	6	6	--	--	--	--	Uncertain
Boechera rectissima (Arabis rectissima var. *simulans)* (Washoe tall rockcress)	2	0	--	--	--	2	Uncertain
Carex davyi (Davy's sedge)	Known only from herbarium / literary records						
Chaenactis douglasii var. alpina (alpine dusty maidens)	11	--	1	1	--	9	Uncertain
Claytonia megarhiza Fell fields claytonia	3	--	1	--	--	2	Uncertain
Cryptantha crymophila (subalpine cryptantha)	No known occurrences on LTBMU; suitable habitat only						
Epilobium palustre (marsh willowherb)	Known only from herbarium / literary records						
Meesia longiseta (meesia moss)	No known occurrences on LTBMU; suitable habitat only						
Myurella julacea (myurella moss)	No known occurrences on LTBMU; suitable habitat only						
Orthotrichum holzingeri (Holzinger's orthotrichum moss)	No known occurrences on LTBMU; suitable habitat only						
Orthotrichum spjutii (Spjut's orthotrichum moss)	No known occurrences on LTBMU; suitable habitat only						
Pohlia tundrae (tundra pohlia moss)	Known only from herbarium / literary records						
Sphagnum spp. (sphagnum moss)	27	--	--	--	--	27	Uncertain (stable)[1]
Tomentypnum nitens (tomentypnum moss)	No known occurrences on LTBMU; suitable habitat only						

[1]Trend could not be assessed for bryophyte or lichen sub-occurrences due to presence/absence data

5.1 *Astragalus austiniae (Austin's milkvetch)*

Austin's milkvetch was added to the LTBMU Watch List in 2014, subsequent to its reclassification to California Rare Plant Rank 1B.3 (Slakey et al. 2013). There are nine known occurrences in California and Nevada, limited to the area within 10 miles of Lake Tahoe on LTBMU, Tahoe NF, and Humboldt-Toiyabe NF (Slakey et al. 2013). It is suspected that at least four occurrences occur on LTBMU: Echo Lake, Mt.

Tallac, Granite Lake and Mt. Rose (California Department of Fish and Wildlife 2015; Slakey et al. 2013). In 2015, all of these locations were surveyed; Austin's milkvetch was found at Echo Peak and Mt. Rose, but at Mt. Tallac or Granite Lake, despite surveying over 700 acres of suitable habitat. In 2015, a third occurrences was discovered incidentally at Relay Peak. As of 2015, there are three occurrences, consisting of six sub-occurrences on 2015. Due to the recent census, no trend can yet be established for the LTBMU.

Table 16. Monitoring visits to Austin's milkvetch occurrences, 2015

LTBMU ID	2015	LTBMU Trend
ASAU1a	5000	new
ASAU1b	5000	new
ASAU2a	1500	new
ASAU2b	500	new
ASAU3a	1500	new
ASAU3b	45	new

5.2 *BOECHERA RECTISSIMA* (WASHOE TALL ROCKCRESS)

Washoe tall rockcress is documented only in northwestern Douglas and southwestern Washoe counties, though may extent into the California portion of the Lake Tahoe Basin (Morefield 2002). The species (*Boechera rectissima)* is considered globally stable (G4G5), but the taxon (var. *simulans*) is considered critically imperiled in Nevada (S1), but also of questionable taxonomy (Q). The most recent taxonomic treatment of *Arabis* and *Boechera* (closely related genera) by Al-Shehbaz—used in both the Jepson Manual and the Flora of North America—does not recognize the variety var. *simulans*, bringing its validity into question (Al-Shehbaz and Windham 2003). The characteristics of Washoe tall rockcress intergrade with those of bristlyleaf rockcress (*B. rectissima* var. *rectissima)* and reflexed rockcress (*B. retrofracta*), making this species difficult to consistently distinguish. Due to this taxonomic confusion, the total number of sub-occurrences on LTBMU as well as the number of plants documented at each sub-occurrence is fairly inaccurate.

In 2015, three locations where Washoe tall rockcress were previously documented (ARRES2,3,4) were confirmed as misidentifications, with all plants in these locations keying to *B. retrofracta* or *B. pinetorum*. ARRES5 was visited in 2012 and confirmed as Washoe tall rockcress. The overall species trend on LTBMU is uncertain.

Table 17. Monitoring visits to Washoe tall rockcress occurrences, 2010-2015

LTBMU ID	2010	2011	2012	2013	2014	2015	LTBMU Trend
ARRES 1	4		X	39			Uncertain[1]
ARRES 5	4		10				Uncertain[1]

5.3 *CHAENACTIS DOUGLASII* VAR. *ALPINA* (ALPINE DUSTY MAIDENS)

There are three known occurrences—consisting of 11 sub-occurrences—of alpine dusty maidens on LTBMU. The occurrences are known from Relay Peak, Freel Peak and Desolation Wilderness. Only two sub-occurrences have been visited after their initial discovery (CHDOA 1a, 1b); one is stable and one is increasing. No trend could be determined for the remaining nine sub-occurrences due to lack of data. The overall species trend on LTBMU is uncertain.

Table 18. Monitoring visits to alpine dusty maiden occurrences, 2009-2015

LTBMU ID	2009	2011	2012	2013	2014	2015	LTBMU Trend
CHDOA1a		50		525			increasing
CHDOA1b		70		70			stable
CHDOA1c		10					uncertain

LTBMU ID	2009	2011	2012	2013	2014	2015	LTBMU Trend
CHDOA1d		10					uncertain
CHDOA1e		25					uncertain
CHDOA2a			20				uncertain
CHDOA2b			175*				uncertain
CHDOA2c			15				uncertain
CHDOA3a			175*				uncertain
CHDOA3b	10						uncertain
CHDOA3c	10						uncertain

*Plant count was estimated as 100-250; mid-value presented.

5.4 *CLAYTONIA MEGARHIZA* (FELL FIELDS CLAYTONIA)

There are three known occurrences of fells fields claytonia on LTBMU—each consisting of one sub-occurrence; all three occur in Desolation Wilderness. One occurrence has not been visited since its initial discovery; census monitoring from 2011-2015 indicate that one occurrence is stable while two are uncertain. The overall species trend on LTBMU is uncertain.

Table 19. Monitoring visits to fell fields claytonia occurrences, 2009-2015

LTBMU ID	2009	2011	2012	2013	2014	2015	LTBMU Trend
CLME1	X						uncertain[1]
CLME2		250+	750*				uncertain
CLME3		250+	375*	250			stable

*Plant count was estimated as 100-249, 250-499 or 500-999; mid-value presented.
[1]Presence of this species was noted on a CNDDB form in 2009 however the total number of plants was not listed.

5.5 *SPHAGNUM SPP.* (SPHAGNUM MOSS)

Sphagnum moss species are often considered indicator species for fens and bogs, which are designated as special aquatic features in the Sierra Nevada Forest Plan Amendment and receive additional management attention (USDA Forest Service 2004b; Weixelman and Cooper 2009). Sphagnum moss is difficult to identify, so collections are made at each sub-occurrence. Collections of sphagnum moss have been made at the following 15 sub-sub-occurrences (SPHAG 2, 4a-f, 5, 6a-c, 7a-b, 9, 10). Due to identification complexity, these specimens remain unclassified in the LTBMU herbarium.

As of 2015, there are 12 known sphagnum moss occurrences—consisting of 27 sub-occurrences—on LTBMU. Only presence/absence data is available for all sub-occurrences; no trend assessment is provide. At Grass Lake and Hell Hole, long-term moss monitoring plots have been established.

6 PLANNING FOR FUTURE RARE PLANT MONITORING

Comprehensive 5-year monitoring of all known rare plant sub-occurrences was scheduled for 2015, but was not conducted due to lack of funding. The last comprehensive monitoring event was in 2009. Funding for a comprehensive monitoring is not likely in 2016, so the following prioritization is provided to assist in planning. Monitoring should focus first on revisits to as many sub-occurrences as possible that are: a) decreasing; b) were newly discovered in 2015; c) of uncertain status; d) were found to have inexplicably large increases; or e) occur within a project area. Among these, the first priority should be to monitor FSS species, with WL species being monitored as funding and scheduling allows. APPENDIX C contains a list of sub-occurrences prioritized for revisits in 2016. If comprehensive monitoring events are unlikely in the future funding climate, future monitoring efforts could be focused on a species-based

rotating schedule; by focusing on visiting all the sub-occurrences of a few given species in a given year—rather than funding one larger unit-wide 'snapshot', it may still be possible to fund a comprehensive monitoring event for each species in a 5-year cycle. Based on the preliminary analysis of the long-term monitoring data for Tahoe draba, Cup Lake draba and long-petaled lewisia, it is highly recommended that attempts be made to continue funding—and if possible expand—this type of long-term, plot-based monitoring.

7 Conclusions

As of 2015, the status and trend of rare botanical species on LTBMU is highly varied and—for some species—relatively uncertain. Overall, as of 2015, approximately 45% of known sub-occurrences were stable, increasing or present, while 16% were decreasing or absent and there were 14% for which a trend could not be effectively detected. This excludes whitebark pine for which occurrence-level monitoring is not conducted and Tahoe yellow cress which assessed via an interagency range-wide survey of sites. Data from long-term monitoring plots for Tahoe draba, Cup Lake draba and long-petaled lewisia appears to improve the ability to assess a trend for these species—all of which are considered relatively stable.

There were seven species that exhibited one or more sub-occurrences that appear to be decreasing or were absent at the most recent census. Census monitoring (i.e. in which only number of plants is monitored) alone cannot substantiate reasons for these decreases, as this type of monitoring does not track potential mechanisms for decrease (e.g. changing environmental conditions, pollinator changes, land use changes). There are several reasons why trend could not be detected at many sub-occurrences, including the following: a) too few years of monitoring data to establish a trend; b) only presence/absence data was collected (particularly for moss and lichen species for which census quantities tend to be too large to count in the time allotted) and could not be used to establish a trend; and c) census quantities were within a margin of error that did not allow for interpretation of a trend. In addition, at several sub-occurrences, survey of adjacent habitat revealed additional individuals, leading to the appearance of a false increase. Those decreasing or uncertain sub-occurrences should be prioritized for future monitoring; including potential long-term monitoring that explores potential mechanisms for decrease. As feasible, future monitoring should phase out the use of presence/absence data for moss and lichen species; long term permanent monitoring plots could be established to quantify change.

Of the 159 known sub-occurrences, only 32% (52 sub-EO) were monitored in 2015, meaning that there are not current data for many sub-occurrences—most of them Watch List species. Despite dwindling earmarked monitoring funds, LTBMU was still able to monitor the majority of FSS sub-occurrences in 2015. Nonetheless, without a comprehensive monitoring event (i.e. in which all known sub-occurrences are monitored), it will remain difficult to ascertain a trend for most of the FSS and WL species monitored. Despite these limitations, the data acquired through the LTBMU's rare botanical species monitoring efforts is able to characterize status and trend for most vascular species and provide a very helpful snapshot of non-vascular species.

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APPENDIX A: 2015 LTBMU BOTANICAL SPECIES LISTS

Federally Threatened, Endangered, Proposed, and Candidate, and R5 Forest Service Sensitive Botanical Species List

Scientific Name	Common Name	Legal Status	Suitable habitat characteristics	Known on LTBMU
Boechera rigidissima (= Arabis rigidissima var. *demota)*	Galena Creek rock cress	FSS	Open, rocky areas along forest edges of conifer and/or aspen stands; usually found on north aspects; 7,500 ft. & above.	X
Boechera tiehmii	Tiehm's rock cress	FSS	Open rocky soils in the Mt. Rose Wilderness; 10,000 ft. & above.	Suitable habitat only
Boechera tularensis	Tulare rockcress	FSS	Shaded, mostly east-facing subalpine rocky areas, including rocky slopes, rock-lined streams and seeps, rocky outcrops, saddles, and canyons; 6,000-11,000 ft.	Known only from herbarium or text records
Botrychium spp.			*Botrychium* species are found in similar habitat; wet or moist soils such as marshes, meadows, and along the edges of lakes and streams; generally occur with mosses, sedges, rushes, and other riparian vegetation; 2,000-10,000 ft.	
Botrychium ascendens	upswept moonwort	FSS	See *Botrychium* spp	X
Botrychium crenulatum	scalloped moonwort	FSS		X
Botrychium lineare	slender moonwort	FSS		Suitable habitat only
Botrychium lunaria	common moonwort	FSS		Suitable habitat only
Botrychium minganense	Mingan moonwort	FSS		X
Botrychium montanum	western goblin	FSS		X
Bruchia bolanderi	Bolander's candle moss	FSS	Mainly in montane meadows and stream banks, but also on bare, slightly eroding soil where competition is minimal.	X
Dendrocollybia racemosa[1]	branched collybia	FSS	On old decayed or blackened mushrooms or occasionally in coniferous duff, usually within old growth stands.	Known only from herbarium or text records
Draba asterophora var. *asterophora*	Tahoe draba	FSS; TRPA	Rock crevices and open granite talus slopes on north-east slopes; 8,000-10,200 ft.	X
Draba asterophora var. *macrocarpa*	Cup Lake draba	FSS; TRPA	Steep, gravelly or rocky slopes; 8,400-9,300 ft.	X
Draba cruciata	Mineral King draba	FSS	Subalpine gravelly or rocky slopes, ridges, crevices, cliff ledges, sink holes, boulder and small drainage edges; 7,800-13,000 ft.	Known only from herbarium or text records
Erigeron miser	starved daisy	FSS	Granitic rock outcrops; 6,000 ft. & above	Suitable habitat only
Eriogonum luteolum var. *saltuarium*	goldencarpet buckwheat	FSS	Sandy granitic flats and slopes, sagebrush communities, montane conifer woodlands; 5,600-7,400 ft.	Suitable habitat only
Eriogonum umbellatum var. *torreyanum*	Donner Pass buckwheat	FSS	Dry gravelly or stony sites; often on harsh exposures (e.g. ridge tops, steep slopes)	Suitable habitat only
Helodium blandowii	Blandow's bog-moss	FSS	Bogs, fens, wet meadows, and along streams under willows.	X
Hulsea brevifolia	short-leaved hulsea	FSS	Red fir forest, but also in mixed conifer forests; found on gravelly soils; 4,900-8,900 ft.	Suitable habitat only

Scientific Name	Common Name	Legal Status	Suitable habitat characteristics	Known on LTBMU
Ivesia sericoleuca	Plumas ivesia	FSS	Vernally wet portions of meadows and alkali flats, vernal pools within sagebrush scrub or lower montane coniferous forest; often on volcanic soils; 4,300-7,200 ft.	Suitable habitat only
Lewisia kelloggii ssp. *hutchisonii*	Kellogg's lewisia	FSS	Ridge tops or flat open spaces with widely spaced trees and sandy granitic to erosive volcanic soil; 5,000-7,000 ft.	Suitable habitat only
Lewisia kelloggii ssp. *kelloggii*	Kellogg's lewisia	FSS	See *Lewisia kelloggii* ssp. *hutchisonii*	Suitable habitat only
Lewisia longipetala	long-petaled lewisia	FSS; TRPA	North-facing slopes and ridge tops where snow banks persist throughout the summer; often found near snow bank margins in wet soils; 8,000-12,500 ft.	X
Meesia uliginosa	broad-nerved hump-moss	FSS	Bogs and fens, but also very wet meadows.	X
Orthotrichum praemorsum	orthotrichum moss	FSS	Shaded, moist habitats of east side of Sierra Nevada rock outcrops; up to 8,200 ft.	Known only from herbarium or text records
Peltigera gowardii	Goward's water fan	FSS	Cold unpolluted streams in mixed conifer forests.	X
Pinus albicaulis	whitebark pine	C; FSS	Subalpine and at timberline on rocky, well-drained granitic or volcanic soils.	X
Rorippa subumbellata	Tahoe yellow cress	FSS; TRPA	Endemic to the shore zone of Lake Tahoe, typically in back beach areas between 6,223 and 6,230 ft.	X

Botanical species includes vascular and non-vascular plants, lichen, and fungi.
There are no federally threatened, endangered, or proposed botanical species known to occur or with known suitable habitat within LTBMU.
This list includes all R5 Sensitive botanical species with known sub-occurrences or known suitable habitat on LTBMU.
Legal status: C—Candidate for federal listing under the Endangered Species Act; FSS—Forest Service Sensitive (Regional Forester's Sensitive Species List, Region 5); TRPA—Tahoe Regional Planning Commission Sensitive Species (TRPA Code of Ordinances 2012)
[1]For branched collybia, surveys are only effective when fruiting bodies are visible. This species typically fruits in late fall -early winter. The extent to which aboveground fruiting bodies are correlated with the abundance of underground structures is unknown. When a survey does not find the fruiting body, the species could still be present at the site. Because of this detection difficulty, it is important to manage habitat in a state that is suitable for fungi.

LTBMU Botanical Species Watch List

Scientific Name	Common Name	Habitat characteristics	Known on LTBMU
Astragalus austiniae	Austin's milkvetch	Rocky ridges and slopes of high peaks above 8,000 ft.	X
Boechera rectissima (= Arabis rectissima var. simulans)	bristlyleaf rock cress	Dry, sandy, granitic or andesitic soil on mostly gentile slopes of all aspects, in full or filtered sunlight of thinly-littered openings in mature, open Jeffrey pine and white fir; 6,000-7,400 ft.	X
Carex davyi	Davy's sedge	Subalpine coniferous forest, Upper montane coniferous forest	X
Chaenactis douglasii var. alpina	alpine dusty maidens	Alpine boulder and rock field (granitic)	X
Claytonia megarhiza	fell fields claytonia	Alpine boulder and rock field (granitic)	X
Cryptantha crymophila	subalpine cryptantha	Subalpine coniferous forest (volcanic, rocky)	Suitable habitat only
Epilobium palustre	marsh willowherb	Bogs and fens, Meadows and seeps(mesic)	Known only from herbarium or text records
Meesia longiseta	meesia moss	Coniferous forests, stream banks, wet meadows, and fens	X

Scientific Name	Common Name	Habitat characteristics	Known on LTBMU
Myurella julacea	myurella moss	Seep like granitic rock walls; on soil over rocks or in crevices in alpine boulder and rock fields; subalpine coniferous forest on damp soil over rocks; 8,800-9,900 ft.	Suitable habitat only
Orthotrichum holzingeri	Holzinger's orthotrichum moss	Seasonally wet rocks in small streams of dry montane forests; 1000--2000 m	Suitable habitat only
Orthotrichum spjutii	Spjut's orthotrichum moss	Volcanic rock walls; Continually misted, shaded granitic rock faces at high elevations near Sonora Pass.	Suitable habitat only
Pohlia tundrae	tundra pohlia moss	Gravelly, damp soils of alpine boulder and rock fields; 8,800-9,900 ft.	Known only from herbarium or text records
Sphagnum spp.	sphagnum moss	Wet meadows, bogs, fens; sea-level to subalpine.	X
Tomentypnum nitens	tomentypnum moss	Forming lawns and hummocks in calcareous, mesotrophic fens in association with other calciphiles, usually found with hypnaceous moss, such as Paludella squarrosa and Aulacomnium spp.	Suitable habitat only

LTBMU maintains a watch list of botanical species that are of conservation concern, but have not been designated as Sensitive by the Regional Forester. This list includes species that are newly described; locally rare; range extensions or disjunct populations; species of specific public interest; or species with too little information to determine their appropriate status. This list was formerly known as 'special interest'.
Survey for and document sub-occurrences of Watch List spp.; do not include in Biological Evaluation.

APPENDIX B: 2015 SUB-OCCURRENCES MONITORED

LTBMU ID	SHP EO	Legal Status (FSS / LTBMU WL)	New, Revisit, Remove or Update GIS in 2015	# in 2015	% Cover 2015	Acres 2015	Notes
ARRES2		LTBMU WL	Remove	5	0	0.02	mis-ID; keys to B. pinetorum
ARRES3		LTBMU WL	Remove	6	0	0.02	mis-ID' keys to B. pinetorum
ARRES4a1		LTBMU WL	Remove	2	0	0.02	mis-ID; keys to B. retrofracta
ARRES4a2		LTBMU WL	Remove	2	0	0.02	mis-ID; keys to B. retrofracta
ARRES4a3		LTBMU WL	Remove	10	0	0.02	mis-ID; keys to B. retrofracta
ARRID1a		FSS	Update	300	0.1 - 1.0	0.24	remapped 2015; may be hybrids; some key to B. platysperma + B. lyallii
ARRID1f		FSS	Remove	0	0	0.08	misID; keys to B.platysperma
ARRID1g		FSS	Update	30	0.1 - 1.0	0.00	remapped in 2015; 200 ft. west upslope of aspen stand
ARRID1i		FSS	Revisit	35	0.1 - 1.0	0.01	between stems of third creek
ARRID1j		FSS	NEW	25	0.1 - 1.0	0.01	200 ft. south of third creek
ARRID2b	1	FSS	Update	230	0.1 - 1.0	0.07	remapped in 2015; co-occurs with B. pinetorum; 800 ft. NW of 16N55 on west side creek
ARRID2c		FSS	NEW	75	0.1 - 1.0	0.02	co-occurs with B. pinetorum; 450 ft. NW of 16N55 on west side creek
ARRID3a		FSS	Remove	0	0	0.08	misID; keys to B. pinetorum /B. sparsiflora
ARRID3b	3	FSS	Remove	0	0	0.08	misID; keys to B. pinetorum
ARRID3c	0	FSS	Remove	0	0	0.08	misID; keys to B.lyallii
ARRID5a		FSS	Remove	0	0	0.08	misID; keys to B. platysperma
ARRID5b		FSS	Remove	0	0	0.08	misID; keys to B.platysperma
ARRID6a		FSS	Remove	0	0	0.08	misID; keys to B. platysperma
ARRID6b		FSS	Remove	0	0	0.10	misID; keys to B.platysperma
ARRID7a	5	FSS	Remove	100	0	0.00	mis-ID; keys to B. platysperma
ARRID7b	6	FSS	Remove	35	0	0.00	mis-ID; keys to B. retrofracta
ASAU1a		LTBMU WL	NEW	5000	0.1 - 1.0	0.81	SW saddle
ASAU1b		LTBMU WL	NEW	5000	0.1 - 1.0	4.00	SW saddle
ASAU2a		LTBMU WL	NEW	1500	0.1 - 1.0	0.41	at summit
ASAU2b		LTBMU WL	NEW	500	0.1 - 1.0	0.39	along W ridge
ASAU3a		LTBMU WL	NEW	1500	0.1 - 1.0	16.94	at summit
ASAU3b		LTBMU WL	NEW	45	0.1 - 1.0	0.94	along N ridge
BOCR1	33	FSS	Update	2	0.1 - 1.0	0.05	
BOCR2	49	FSS	Revisit	127	0.1 - 1.0	5.12	Heavenly Valley Ck N trib; 2015 cnt down to 127 from 800 in 2011
BOCR3		FSS	Revisit	62	0.1 - 1.0	0.03	creek above Zephyr Cove; 2015 cnt down to 62 from 127 in 2013

LTBMU ID	SHP EO	Legal Status (FSS / LTBMU WL)	New, Revisit, Remove or Update GIS in 2015	# in 2015	% Cover 2015	Acres 2015	Notes
BOCR4	52	FSS	Update	66	0.1 - 1.0	0.01	2 clusters
BOMI1	17	FSS	Revisit	0	0.1 - 1.0	0.02	in 2015, could not locate BOMI. Litter layer is thick, very little bare ground / moss on ground.
BOMI2		FSS	Update	42	0.1 - 1.0	0.37	Trout Creek trib; remapped poly in 2015
BOMO1	9	FSS	Revisit	13	0.1 - 1.0	0.01	within 10 ft. of social trail
BRBO2		FSS	Revisit	0	0.1 - 1.0	0.00	1x1cm gross area; not present in 2014, 2015
BRBO3b1		FSS	Update	0	0.1 - 1.0	0.00	not present in 2015; poly moved 50 ft. S to 2010 photo pt
BRBO3b2		FSS	NEW	1	0.1 - 1.0	0.00	5cm x 5cm; new in 2015; 200ft SW of BRBO3b1
BRBO3c		FSS	NEW	1	1.1 - 5.0	0.00	new in 2015; 15cm x 40cm
BRBO5		FSS	Revisit	1	0.1 - 1.0	0.04	present in 2015
BRBO8		FSS	Revisit	1	0.1 - 1.0	0.08	Upper Truckee River trib; present in 2015
DRASA1a	1	FSS	Revisit	1000	0.1 - 1.0	34.98	l/t monitor plots
DRASA1b	1	FSS	Update	3200	0.1 - 1.0	77.29	1b, c + q merged 2015; contiguous habitat; l/t monitor plots
DRASA1c		FSS	Merge				in 2015, merged into DRASA1b
DRASA1d	1	FSS	Revisit	1000	0.1 - 1.0	4.50	l/t monitor plots
DRASA1f	9	FSS	Revisit	5000	0.1 - 1.0	0.00	
DRASA1j	4	FSS	Update	1000	0.1 - 1.0	0.69	l/t monitor plots
DRASA1q		FSS	Merge				in 2015, combined into DRASA1b
DRASA2a1	10	FSS	Revisit	535	1.1 - 5.0	0.25	within 100ft of DRASA2a2 but separated by large road
DRASA2a2	10	FSS	Revisit	483	1.1 - 5.0	0.35	within 100ft of DRASA2a1 but separated by large road
DRASA2b	10	FSS	Revisit	891	1.1 - 5.0	0.39	l/t monitor plots
DRASA2c	10	FSS	Revisit	2151	1.1 - 5.0	0.70	
DRASA2d	10	FSS	Revisit	160	1.1 - 5.0	0.10	
DRASA2e	10	FSS	Revisit	320	1.1 - 5.0	0.48	
DRASA2g	10	FSS	Revisit	215	0.1 - 1.0	0.43	Plt cnt decreased from 417 in 2013 to 215 in 2015
DRASA2h	10	FSS	Update	1015	0.1 - 1.0	15.47	remapped poly 2015
DRASA2j	10	FSS	Revisit	1000	0.1 - 1.0	2.94	
DRASA2k	10	FSS	Update	2	0.1 - 1.0	0.02	
DRASA2n	10	FSS	Revisit	21	0.1 - 1.0	0.03	
DRASA2o	10	FSS	Revisit	50	0.1 - 1.0	0.03	

LTBMU ID	SHP EO	Legal Status (FSS / LTBMU WL)	New, Revisit, Remove or Update GIS in 2015	# in 2015	% Cover 2015	Acres 2015	Notes
DRASA3a		FSS	Revisit	1000	0.1 - 1.0	17.60	
DRASA3c		FSS	Revisit	1000	0.1 - 1.0	6.79	
DRASA3d	11	FSS	Revisit	10	0.1 - 1.0	0.02	
DRASA3e	11	FSS	Update	180	0.1 - 1.0	0.89	4 polys: W--75 plts, N--75 plts, Mid--10 plts, E--20 plts; UTM for W
DRASA3e1		FSS	Merge	20	0.1 - 1.0	0.16	merged into multipart poly due to proximity
DRASA3e2		FSS	Merge	10	0.1 - 1.0	0.12	merged into multipart poly due to proximity
DRASA3e3		FSS	Merge	75	0.1 - 1.0	0.41	merged into multipart poly due to proximity
DRASA3e4		FSS	Merge	75	0.1 - 1.0	0.20	merged into multipart poly due to proximity
DRASA3g		FSS	Update	6	0.1 - 1.0	0.02	above (west) of Incline Lake
DRASA3h		FSS	Revisit	20	0.1 - 1.0	0.02	
DRASM1b	2	FSS	Revisit	1000	0.1 - 1.0	3.09	W side saucer lk; l/t monitor plots
DRASM1e	2	FSS	Revisit	500	0.1 - 1.0	4.04	ridge W of saucer lk; l/t monitor plots
LELO1a	7	FSS	Revisit	7860	0.1 - 1.0	0.79	(only visited eastmost poly); last complete census in 2009 (7860 plants for all 6 polys)
LELO3a	3	FSS	Revisit	1000	0.1 - 1.0	0.09	l/t monitor plots
ROSU1	901	FSS	Revisit	4	0	0.00	prior to 2015, named ROSU1s
ROSU2a	917	FSS	Update	3	0.1 - 1.0	0.09	prior to 2015, named ROSU1b; remapped in 2015; plts found outside fence
ROSU2b	917	FSS	Revisit	10	0.1 - 1.0	0.00	prior to 2015, named ROSU1a2 or part of ROSU1a
ROSU2c	917	FSS	Update	27	0.1 - 1.0	0.02	prior to 2015, named ROSU1a1 or part of ROSU1a; remapped in 2015
ROSU2d	917	FSS	Revisit	1200	1.1 - 5.0	0.04	prior to 2015, named ROSU1a4 or ROSU1w; remapped in 2015
ROSU2e	917	FSS	Revisit	10	1.1 - 5.0	0.00	prior to 2015, named ROSU1a3 or ROSU1v
ROSU8	8	FSS	Update	1000	0.1 - 1.0	0.16	prior to 2015, named ROSU1f or 'NVBchFence'; NV Beach enclosure
ROSU9	9	FSS	Update	112	0.1 - 1.0	0.24	prior to 2015, listed as ROSU1m

APPENDIX C. 2016 PRIORITIES FOR MONITORING

LTBMU ID	Priority	Species	Status[1]	Rationale
	HIGH	**10 sub-EO**		
BOAS2	High	*Botrychium ascendens*	FSS	intersects fuels implementation project
BOAS3a	High	*Botrychium ascendens*	FSS	intersects fuels implementation project
BOAS3b	High	*Botrychium ascendens*	FSS	intersects fuels implementation project
BOAS3c	High	*Botrychium ascendens*	FSS	intersects fuels implementation project
BOAS4	High	*Botrychium ascendens*	FSS	Decreasing in 2015
DRASA2d	High	*Draba asterophora var. asterophora*	FSS	Intersects Heavenly Epic
DRASA2e	High	*Draba asterophora var. asterophora*	FSS	Intersects Heavenly Epic
DRASA2g	High	*Draba asterophora var. asterophora*	FSS	Intersects Heavenly Epic
DRASA2h	High	*Draba asterophora var. asterophora*	FSS	Intersects Heavenly Epic
DRASA2k	High	*Draba asterophora var. asterophora*	FSS	Intersects Heavenly Epic
	MEDIUM	**13 sub-EO**		
ARRID1g	Medium	*Boechera rigidissima*	FSS	Decreasing in 2015
ARRID1j	Medium	*Boechera rigidissima*	FSS	New in 2015
ARRID2c	Medium	*Boechera rigidissima*	FSS	New in 2015
BOCR2	Medium	*Botrychium crenulatum*	FSS	Uncertain in 2015
BOCR3	Medium	*Botrychium crenulatum*	FSS	Decreasing in 2015
BOMO2	Medium	*Botrychium montanum*	FSS	Decreasing in 2015
BRBO2	Medium	*Bruchia bolanderi*	FSS	Absent in 2015
BRBO3b1	Medium	*Bruchia bolanderi*	FSS	Absent in 2015
BRBO3b2	Medium	*Bruchia bolanderi*	FSS	New in 2015
BRBO3c	Medium	*Bruchia bolanderi*	FSS	New in 2015
HEBL2b	Medium	*Helodium blandowii*	FSS	Absent in 2015
PEGO2a	Medium	*Peltigera gowardii*	FSS	intersects West Shore WUI
PEGO2b	Medium	*Peltigera gowardii*	FSS	intersects West Shore WUI
	LOW	**22 sub-EO**		
BOMI1	Low	*Botrychium minganense*	FSS	Decreasing in 2015
DRASA1e	Low	*Draba asterophora var. asterophora*	FSS	intersects TRT race permits
DRASA1k	Low	*Draba asterophora var. asterophora*	FSS	intersects TRT race permits
ARRES1	Low	*Boechera rectissima*	LTBMU WL	confirm spp ID
ARRES5	Low	*Boechera rectissima*	LTBMU WL	confirm spp ID
ASAU1a	Low	*Astragalus austiniae*	LTBMU WL	New in 2015
ASAU1b	Low	*Astragalus austiniae*	LTBMU WL	New in 2015
ASAU2a	Low	*Astragalus austiniae*	LTBMU WL	New in 2015
ASAU2b	Low	*Astragalus austiniae*	LTBMU WL	New in 2015
ASAU3a	Low	*Astragalus austiniae*	LTBMU WL	New in 2015
ASAU3b	Low	*Astragalus austiniae*	LTBMU WL	New in 2015
CHDOA1c	Low	*Chaenactis douglasii var. alpina*	LTBMU WL	Uncertain in 2015
CHDOA1d	Low	*Chaenactis douglasii var. alpina*	LTBMU WL	Uncertain in 2015
CHDOA1e	Low	*Chaenactis douglasii var. alpina*	LTBMU WL	Uncertain in 2015
CHDOA2a	Low	*Chaenactis douglasii var. alpina*	LTBMU WL	Uncertain in 2015
CHDOA2b	Low	*Chaenactis douglasii var. alpina*	LTBMU WL	Uncertain in 2015
CHDOA2c	Low	*Chaenactis douglasii var. alpina*	LTBMU WL	Uncertain in 2015
CHDOA3a	Low	*Chaenactis douglasii var. alpina*	LTBMU WL	Uncertain in 2015
CHDOA3b	Low	*Chaenactis douglasii var. alpina*	LTBMU WL	Uncertain in 2015
CHDOA3c	Low	*Chaenactis douglasii var. alpina*	LTBMU WL	Uncertain in 2015
CLME1	Low	*Claytonia megarhiza*	LTBMU WL	Uncertain in 2015
CLME2	Low	*Claytonia megarhiza*	LTBMU WL	Uncertain in 2015
	TOTAL	**45 sub-EO**		

[1]FSS—Forest Service Sensitive Species; LTBMU WL—Lake Tahoe Basin Management Unit Watch List;

APPENDIX D: ESTIMATION OF WHITEBARK PINE ABUNDANCE AND DISTRIBUTION ON THE LAKE TAHOE BASIN MANAGEMENT UNIT (LTBMU)

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March 2013

There is a high level of uncertainty regarding the abundance and distribution of whitebark pine on LTBMU. Currently, the best available spatial data for estimating the abundance and distribution of whitebark pine on the LTBMU is a combination of the Potential Natural Vegetation (PNV) data in the Terrestrial Ecological Unit Inventory (TEUI) and the Region 5's Existing Vegetation (EVeg) data. Both feature classes are located in the LTBMU Geographic Information System (GIS) library and are at 1:24,000.

The EVeg feature class is a USDA Forest Service dataset that classifies existing vegetation following national and regional guidance. This dataset uses a minimum of 2.5 acres based on cover type, vegetation type, tree cover, and tree diameter. It was last updated in 2005, except for the Angora Fire portion which was updated after the fire. Regional dominance types were used to identify stands where whitebark is dominant or the potential for whitebark as a common associate is highly likely. There are 1,518 acres identified as whitebark pine alliance (WB), where whitebark pine is considered dominant (table 1). This likely greatly underestimates the abundance of whitebark pine because it does not include stands where whitebark pine may be present, but it not dominant. Using additional regional dominate types where whitebark pine is a common associate-- subalpine conifer alliance (SA), western white pine alliance (WW), low sagebrush alliance (BL), upper montane mixed shrub alliance (CM), and the alpine mixed grasses and forbs alliance (AC)—there are an additional 17,791 acres in which whitebark pine is highly likely.

Table 20. Regional dominance types where whitebark pine may be present and total acres on the LTBMU (based on the R5 EVeg dataset)

Alliance	Sum of Acres
AC	748
BL	571
CM	4,257
SA	11,982
WW	233
Subtotal	*17,791*
WB	1,518
Grand Total	**19,309**

The PNV feature class was revised in 2005 from the TEUI team based on the PNV dataset delivered by AMSET. Changes were based on Natural Resource Conservation Service plot data, aerial photo interpretation, and 2005 field visits. Potential Natural Vegetation is the vegetation that is predicted to dominate a site in the long-term absence of disturbance – "ecological potential". Potential natural vegetation is important because it provides information on likely growth potential of site based on physical variables and successional pathways. This dataset was selected as appropriate for the assessment of whitebark pine on LTBMU because in landscapes where disturbance is not common (e.g. subalpine and alpine habitats), PNV and existing vegetation are often equal. At the highest elevations on LTBMU, whitebark pine is often forms a mosaic with drier herbaceous communities and in rocky sites with low vegetation cover. The PNV feature class only assigned a vegetation type to sites with greater than 10% cover. This feature class is appropriate for landscape scale applications, but it does not provide enough resolution for mapping of individual trees. The assessment incorporates all PNV attributes that identify whitebark pine (PNV 1, 2, or 3). This encompasses open subalpine forests with scattered stunted (krummholz) or full-grown trees. Juniper, western white pine, and lodge pole pine occur in low densities. There are 9,877 acres of whitebark pine PNV stands on the LTBMU.

When the two feature classes are unioned, there is a total of 24,387 acres of land where whitebark pine may be present (Figure 1). The two feature classes overlap for a total of 5,079 acres where both suggest whitebark pine is present. This data may over- or under- estimate the total abundance of LTBMU's whitebark pine population. More importantly, due to the minimum stand size analyzed to produce these date sets, they do not capture scattered trees and small stands. Therefore, they cannot provide an accurate distribution estimate on the project level. Within proposed project areas, field verification of whitebark pine abundance and distribution is critical to assessing effects to individuals and well as to population viability.

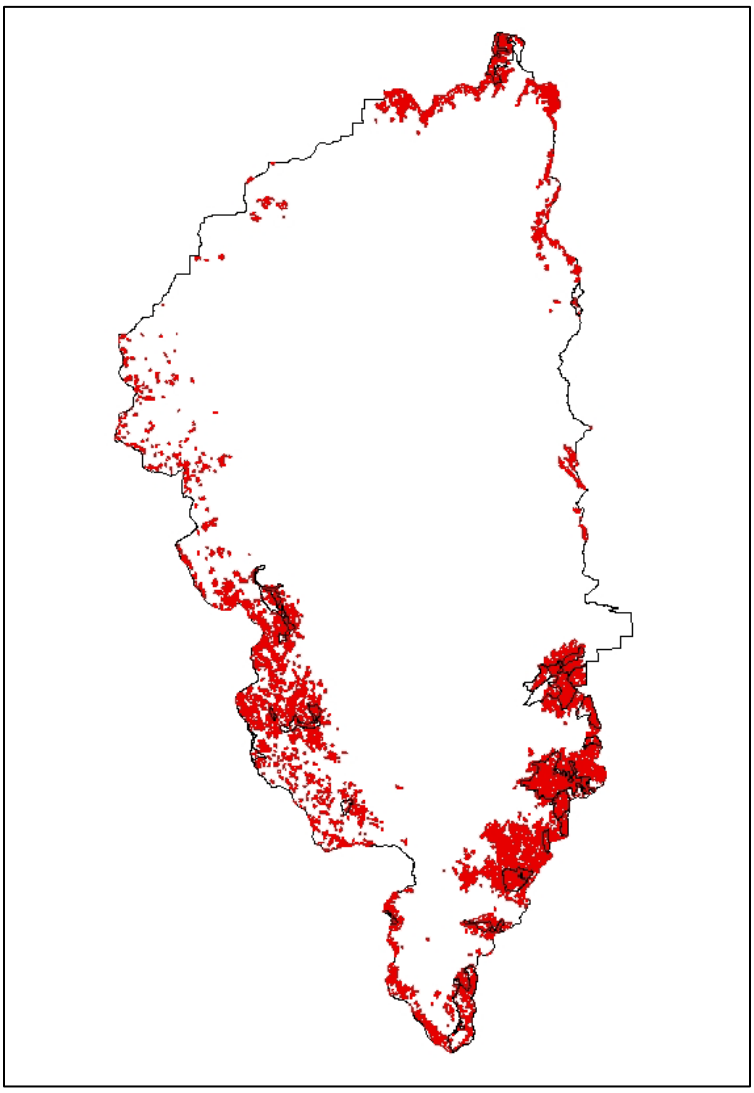

Figure 5. Map of potential distribution of whitebark pine on LTBMU. Red polygons indicate where the Existing Vegetation data (EVeg) suggests the presence of whitebark pine and black hollow polygons indicate where the Potential Natural Vegetation (PNV) feature class suggests the presence of whitebark pine.