# LTBMU Sensitive Plant Species and Habitat - 2010 Monitoring Report

## USDA Forest Service, Lake Tahoe Basin Management Unit

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## 1. EXECUTIVE SUMMARY

This report summarizes 2010 activities related to monitoring the status and trend of 1) sensitive, special interest, and target plant species (vascular and non-vascular), 2) fungi diversity, and 3) sensitive plant communities including fens, Tahoe Regional Planning Agency (TRPA) threshold sites, and meadows. In 2010, 68 existing sensitive plant sites were revisited and 14 new sites were found. Long-term monitoring was established and conducted at nine *Draba asterophora* populations. Long-term monitoring of *Lewisia longipetala* was established at one population each in 2009 and 2010; both populations were monitored in 2010. All three fungi diversity plots were revisited in 2010; a total of 37 species were found, including two uncommon *Mycena* species. Twenty potential fen sites were visited in 2010; based on field assessments and soil analyses, 14 of these sites were confirmed as fens, bringing the total number of confirmed fens in the Lake Tahoe Basin to 47. Grass Lake was the only TRPA threshold site visited in 2010; one meadow plot was resurveyed and comprehensive moss monitoring was completed for the entire site. Ten meadow plots were revisited and four new meadow plots were established.

## 2. SENSITIVE PLANT STATUS & TREND

The Lake Tahoe Basin Management Unit (LTBMU) monitors the status and trend of Forest Service sensitive plant species known to occur in the basin, as well as Tahoe Regional Planning Agency (TRPA) special interest plant species and LTBMU target plant species. National Forests are tasked with managing sensitive plants to ensure that they do not become threatened or endangered because of Forest Service activities (USDA FS 1988; FSM 1995). The primary management action related to this direction is to ensure that existing habitat of these plants is adequately protected and that additional habitat is provided to sustain the species into the future (USDA FS 1988). TRPA vegetation thresholds are designated to provide for the conservation of sensitive plant species and uncommon plant communities in the Lake Tahoe Basin. For sensitive plants, the indicator of threshold attainment is “the number of population sites that are maintained as suitable habitat as determined by a qualified expert.” LTBMU target species are species for which it was determined that management actions may be

necessary or desirable to achieve ecological or other multiple-use objectives for the species. This designation may result from conservation concerns due to changes in populations or available habitat, threats to the species or their habitats, and/or high levels of public interest. Appendix 1 contains a complete list of sensitive, special interest, and target plant species that are addressed by the LTBMU, including sensitive species that have not yet been observed on the LTBMU but occur near Lake Tahoe and/or have suitable habitat within the basin.

A comprehensive monitoring program for LTBMU target plant species was initiated in 2004. The objective of this monitoring program is to track the status and trend of all known target plant species populations in the LTBMU. In order to meet this objective, plant populations are visited every five years. In addition, populations are visited more frequently when 1) they are new occurrences (to obtain a minimum of two years of baseline data), 2) data suggests that the population is decreasing, or 3) the population is of unknown status. Plant populations are assigned to an element occurrence (EO) and a sub-element occurrence (sub-EO). Two populations are considered to be part of the same EO if they 1) occur within one kilometer of each other, 2) occur within three kilometers of each other and are connected by suitable habitat, or 3) occur within 10 km of each other and are connected by uninterrupted linear water-current flow along a riparian or lakeshore system (NatureServe 2004). Within an EO, populations or individual plants are assigned to separate sub-EOs (e.g. a, b, c) if they are non-contiguous with the rest of the EO and it is more practical or precise to survey them as separate population.

The most recent comprehensive monitoring occurred in 2009. In 2010, revisits were made to occurrences that were declining based on the 2009 visits, or the occurrence was new in 2009 and an additional year of baseline data was desired. The current status of all target plant species as of 2010 is summarized in Table 1, with the exception of *Rorippa subumbellata* (Tahoe Yellow Cress). *Rorippa subumbellata* is monitored annually by the Adaptive Management Working Group (AMWG) and the status of this species is discussed separately in AMWG annual reports. In 2010, 68 sensitive plant occurrences were revisited and 14 new sensitive plant occurrences were found. Table 2 summarizes the number of visited and known sites for each species from 2002 through 2010. Revisits in 2011 will consist of visits to occurrences that are decreasing or of unknown status.

**Table 1**: Population trends[†] of target plant species known to occur on the Lake Tahoe Basin Management Unit.

| Species | Status[^] | Total EO and Sub-EOs | New 2010 | Stable | Increase | Decrease | Unknown |
|---|---|---|---|---|---|---|---|
| *Arabis rectissima* var. *simulans* | LTBMU | 5 | 5 | 0 | 0 | 0 | 0 |
| *Arabis rigidissima* var. *demota* | S, SI | 14 | 1 | 1 | 0 | 3 | 9 |
| *Botrychium ascendens* | S | 6 | 1 | 0 | 1 | 4 | 0 |
| *Botrychium crenulatum* | S | 2 | 0 | 1 | 0 | 1 | 0 |
| *Botrychium minganense* | S | 2 | 0 | 0 | 1 | 1 | 0 |
| *Botrychium montanum* | S | 1 | 0 | 0 | 0 | 1 | 0 |
| *Bruchia bolanderi* | S | 7 | 0 | 0 | 0 | 0 | 7 |
| *Claytonia megarhiza* | LTBMU | 1 | 0 | 0 | 0 | 0 | 1 |
| *Dendrocollybia racemosa* | S | 1 | 0 | 0 | 0 | 0 | 1 |
| *Draba asterophora* var. *asterophora* | S, SI | 34 | 0 | 22 | 3 | 1 | 8 |
| *Draba asterophora* var. *macrocarpa* | S, SI | 7 | 0 | 3 | 2 | 1 | 1 |
| *Epilobium howellii* | S | 6 | 1 | 0 | 0 | 5 | 0 |
| *Helodium blandowii*[#] | S | 3 | 0 | 0 | 0 | 0 | 3 |
| *Lewisia longipetala* | S, SI | 8 | 0 | 4 | 2 | 2 | 0 |
| *Meesia triquetra*[#] | S | 22 | 0 | 0 | 0 | 1 | 21 |
| *Meesia uliginosa*[#] | S | 2 | 0 | 0 | 0 | 0 | 2 |
| *Orthotrichum shevockii* | LTBMU | 2 | 0 | 1 | 0 | 0 | 1 |
| *Peltigera hydrothyria* | S | 1 | 0 | 0 | 0 | 0 | 1 |
| *Scutellaria galericulata* | LTBMU | 3 | 1 | 0 | 0 | 0 | 3 |
| *Sphagnum* spp.[#] | LTBMU | 20 | 5 | 0 | 0 | 0 | 15 |

[†]Population trend was determined by comparing the total number of plants from the date the population was first observed to the total number of plants observed in 2009 or 2010 (whichever was the most recent census). All site visits were within two weeks of the date the population was first observed.

[^]S=Region 5 Forest Service Sensitive; SI=TRPA Special Interest; LTBMU=LTBMU Target plant species.

[#]Populations of these bryophyte species are listed as either unknown (the site was still present) or decrease (the site was absent).

**Table 2.** Census history for known populations of LTBMU target plant species. Number of element and sub-element occurrences visited during respective year with the total number of sites in parentheses.

| **Species** | **2002** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
|---|---|---|---|---|---|---|---|---|
| *Arabis rectissima* var. *simulans* | - | - | - | - | - | - | - | 5 (5) |
| *Arabis rigidissima* var. *demota** | - | 11 (11) | 6 (17) | - | - | - | 17 (17) | 5 (14) |
| *Botrychium spp.* | 1 (1) | 1 (1) | 2 (2) | 1 (3) | 2 (4) | 6 (9) | 10 (10) | 8 (11) |
| *Botrychium ascendens* | - | - | - | - | 1 (1) | 4 (5) | 5 (5) | 6 (6) |
| *Botrychium crenulatum* | 1 (1) | 1 (1) | 1 (1) | - | - | 1 (1) | 2 (2) | 1 (2) |
| *Botrychium minganense* | - | - | 1 (1) | - | - | 1 (1) | 2 (2) | 2 (2) |
| *Botrychium montanum* | - | - | - | 1 (1) | 1 (1) | - | 1 (1) | - |
| *Bruchia bolanderi* | - | - | - | 1 (1) | - | - | 5 (7) | 5 (7) |
| *Claytonia megarhiza* | - | - | - | - | - | - | 1 (1) | - |
| *Dendrocollybia racemosa* | - | - | - | - | - | - | - | - |
| *Draba asterophora* var. *asterophora* | - | 22 (23) | 3 (28) | - | - | - | 34 (34) | 10 (34) |
| *Draba asterophora* var. *macrocarpa* | - | 6 (7) | - | - | - | - | 7 (7) | 3 (7) |
| *Epilobium howellii* | - | - | - | 1 (1) | 4 (4) | - | 5 (5) | 5 (6) |
| *Helodium blandowii* | - | - | - | - | - | - | 3 (3) | - |
| *Lewisia longipetala* | 2 (2) | 6 (6) | - | 1 (7) | - | - | 8 (8) | 7 (8) |
| *Meesia triquetra* | - | 7 (7) | 4 (10) | - | 1 (11) | 2 (13) | 20 (22) | 7 (22) |
| *Meesia uliginosa* | - | - | 2 (2) | - | - | - | 2 (2) | - |
| *Orthotrichum shevockii* | - | - | - | - | - | - | 1 (2) | 2 (2) |
| *Peltigera hydrothyria* | - | - | - | - | - | 1 (1) | - | - |
| *Scutellaria galericulata* | - | - | - | - | - | - | 3 (3) | 2 (4) |
| *Sphagnum* spp. | - | - | - | - | 2 (2) | 4 (6) | 14 (14) | 14 (20) |

*Four populations were determined not to be ARRID in 2010, but one new population was found, decreasing the total number of ARRID sites from 17 in 2009 to 14 in 2010.

Target vascular plant population monitoring consists of census counts. The counting unit is the individual stem or rosette, depending on the species. At very large populations, classes are used instead of a census count to reduce error associated with counting large numbers of plants and to improve consistency when identifying individual plants of small stature and/or various stage classes. The classes used for monitoring are: a complete census if less than 100 individuals, 100-249, 250-499, 500-999, and 1000+. Assessments of population status are solely based on census counts and not on statistical analyses due to insufficient replication and the rarity of the plant species.

In addition to census counts, comprehensive long-term monitoring was initiated for *Draba asterophora* var. *asterophora* (Tahoe draba) and *Draba asterophora* var. *macrocarpa* (Cup Lake draba) in 2010 (Engelhardt & Gross 2011) and for *Lewisia longipetala* (Long-petaled lewisia) in 2009 (Engelhardt & Gross 2011b). The intent of the intensive monitoring is to more quantitatively and consistently determine the status and trend of the populations. The populations selected for monitoring are comprised of large numbers of plants, making it difficult to accurately count individuals or determine population trends. Monitoring in permanent plots allows for more repeatable and efficient surveys.

Target 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 and trend of target moss and lichen species, the area of the population (square meters) and ocular cover within that area is estimated. Revisits provide a way to assess presence/absence of previously identified populations and changes in the ocular cover provide insight into population trends. However, percent cover varies over time and estimates of cover vary between observers. For these reasons, trends beyond presence/absence are currently not available. Future moss and lichen monitoring may involve permanent markers and the use of sampling techniques to provide more quantitative trend data. In addition to presence/absence and cover monitoring for non-vascular species, comprehensive long-term monitoring was initiated in 2004 at Grass Lake Research Natural Area for *Meesia triquetra* and *Sphagnum* spp. (Engelhardt & Gross 2011c), and in 2006 at the Angora Fen for *M. triquetra* and *M. uliginosa.*

***Arabis rectissima* var. *simulans***

The characteristics of *Arabis rectissima* var. *simulans* intergrade with those of *A. rectissima* var. *rectissima* and *A. holboellii*, making this species difficult to consistently distinguish. The validity of this separate variety is questionable based on our assessments to date. Prior to 2010, individual plants had been potentially identified on the LTBMU but not confirmed as *A. rectissima* var. *simulans*. In 2010, five small populations of *Arabis rectissima* var. *simulans* were tentatively identified on the LTBMU. Four of these populations had 3-6 plants and one had 16 plants.

***Arabis rigidissima* var. *demota***

*Arabis rigidissima* var. *demota* is a challenging species to identify. This species hybridizes with *A. platysperma* and consistently distinguishing between these species and

the hybrid is problematic. Initial population counts are not available for many of the known populations due to the difficulty in species identification. For this species presence/absence is the most reliable data that may be collected. In 2009, three populations that occurred at Heavenly Ski Resort were not found. In 2010, four populations near Incline Lake were conclusively determined not to be *A. rigidissima* var. *demota*. Fieldwork in 2011 will focus on visiting as many *A. rigidissima* var. *demota* populations as possible to determine species identification and validity.

***Botrychium* spp.**

All *Botrychium* spp. experienced decreases at some of their populations in 2010 (Table 3). Four of six *B. ascendens* populations decreased, one population increased, and one new population was discovered in 2010. All of these populations are relatively small (<50 individuals at greatest number) and in 2010, none of the populations had more than 15 individuals. While the historical population of *B. crenulatum* (BOCR1) declined by one plant from the initial observation date, this population has been monitored annually from 2002 to 2009 and has consistently fluctuated between two to three plants and is currently considered stable. The *B. crenulatum* population (BOCR2) first discovered in 2009 initially had 800-1000 plants, but in 2010 only 169 plants were found. This decline may be a result of the survey not covering the entire population and the site will be revisited in 2011. The *B. minganense* population discovered in 2005 (BOMI1) originally had two plants but no plants were found in either 2009 or 2010. The other population of *B. minganense* (BOMI2) increased from three plants in 2008 to four plants in 2010. The lone population of *B. montanum*, which was initially found in 2006, could not be relocated in 2010.

While many *Botrychium* populations declined, it is difficult to conclude if this is a true negative trend or if it can be explained by the life history of *Botrychium* spp. *Botrychium* population sizes can vary greatly from year to year and it is not uncommon for adjacent populations to increase and decrease simultaneously (Montgomery 1990, Muller 1992, 1993; Johnson-Groh and Farrar 1993; Lesica and Ahlenslager 1996; Johnson-Groh 1997). In addition to variability at the population level, individual plants may remain dormant underground during some years, and then emerge and produce aboveground plants the following season (Montgomery 1990; Muller 1992, 1993; Lesica and Ahlenslager 1996; Johnson-Groh 1998). New plants are recruited into the population annually, but mature plants may disappear and then reappear after 1-3 years (Johnson-Groh 1998). Future monitoring of *Botrychium* populations will help to determine whether observed fluctuations are due to a decline in populations or part of the inter-annual variability often seen in populations of this genus.

**Table 3.** Number of plants observed at each of the LTBMU *Botrychium* element and sub-element occurrences from 2002 to 2010.

| LTBMU EO | 2002 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Trend* | 2011 Visit? |
|---|---|---|---|---|---|---|---|---|---|---|
| **BOAS 1** | - | - | - | - | 4 | - | 1 | 8 | Increase | - |
| **BOAS 2** | - | - | - | - | - | 41 | 4 | 15 | Decrease | X |
| **BOAS 3c** | - | - | - | - | - | 29 | 2 | 1 | Decrease | X |
| **BOAS 3a** | - | - | - | - | - | 14 | 5 | 1 | Decrease | X |
| **BOAS 3b** | - | - | - | - | - | 14 | 1 | 0 | Decrease | X |
| **BOAS 4** | - | - | - | - | - | - | - | 5 | New in 2010 | X |
| **BOCR 1** | 3 | 2 | 3 | - | - | 2 | 2 | - | Stable | - |
| **BOCR 2** | - | - | - | - | - | - | 800-1000 | 169[#] | Decrease? | X |
| **BOMI 1** | - | - | 2 | - | - | - | 0 | 0 | Decrease | X |
| **BOMI 2** | - | - | - | - | - | 3 | 1 | 4 | Increase | - |
| **BOMO 1** | - | - | - | 34 | - | - | 5 | 0 | Decrease | X |

*Population trend is determined by comparing the number of plants at the most recent and initial visits.

[#]This decrease may be due to an incomplete survey as opposed to a true decrease in population number.

***Bruchia bolanderi***

As of 2010, there were seven occurrences of *Bruchia bolanderi* (Table 1); all were of unknown status (due to only one site visit or variability in estimates of population size). Due to the small stature of this species it can be challenging to find and/or quantify population extent, especially when the species is not fruiting. Population size may vary depending on the timing of surveys because *B. bolanderi* plants senesce after spore dispersal, although spores are generally not set until late fall or early winter. This species does not compete well with other plants, therefore some disturbance is necessary to maintain open habitat (Harpel 2008). One population, BRBO6, is found within the boundaries of the Cookhouse Meadow Restoration Project; disturbance associated with this project may have provided additional habitat for this population. Additional efforts will be made during future monitoring to quantify population sizes so that population trends can be determined.

***Draba asterophora* var. *asterophora***

Overall, *Draba asterophora* var. *asterophora* is relatively stable. In 2010, of the 34 sub-element occurrences of *D. asterophora* var. *asterophora*, 3 increased, 1 decreased, 22 were stable, and 8 were of unknown status due to only one census count or the inability to completely survey the population because of safety concerns (Figure 1). DRASA 3h, the population that decreased, is near Mt Rose. It was first identified in 2009 with 30 individuals but was not relocated in 2010. This population will be revisited in 2011. The populations at Heavenly Ski Area (DRASA 2) were all stable as of 2010, based on 2010 census counts that were similar to the first observation of each population.

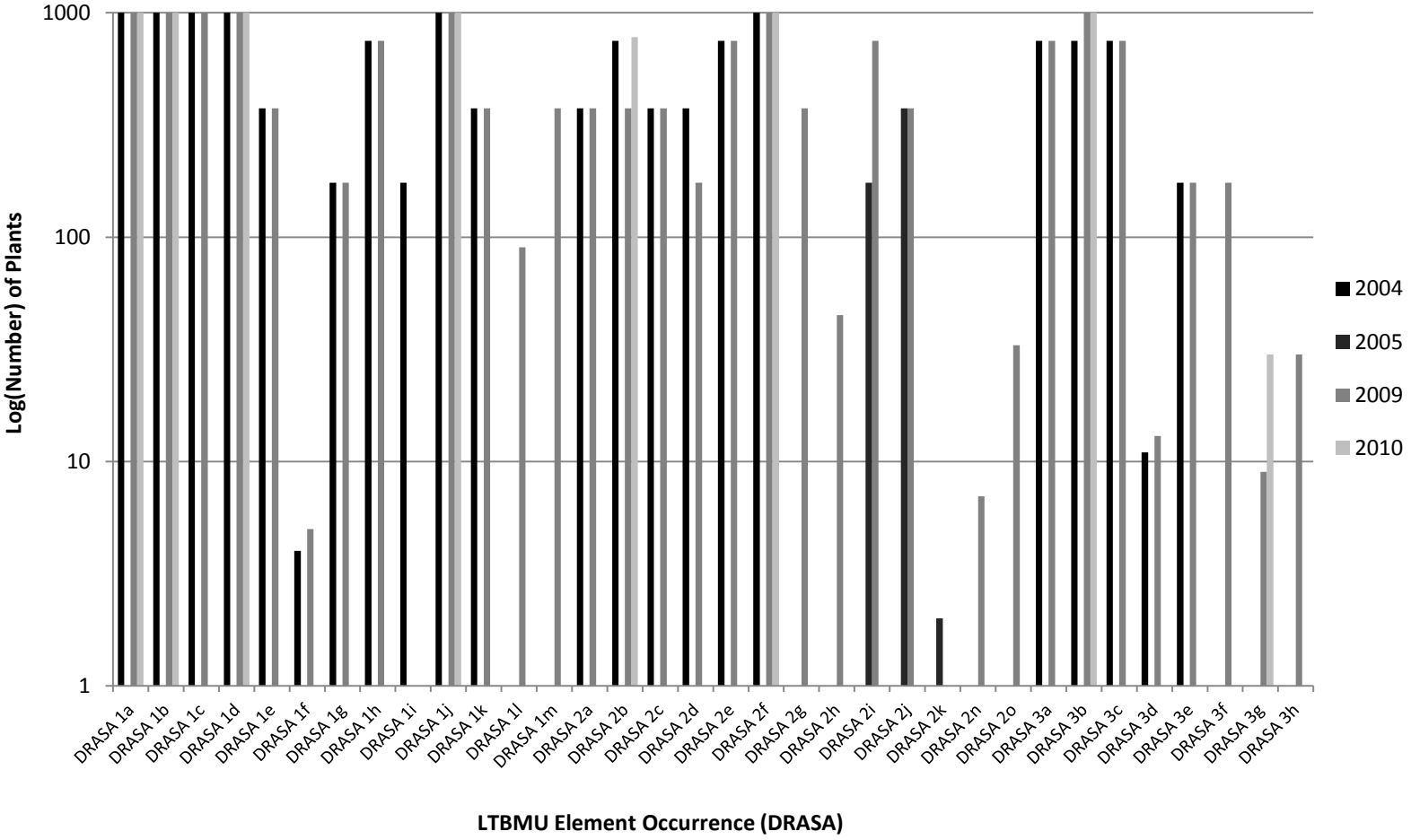


**Figure 1.** Census results of *Draba asterophora* var. *asterophora* populations on the LTBMU from survey years 2004, 2005, 2009, and 2010.

***Draba asterophora* var. *macrocarpa***

The overall status of *Draba asterophora* var. *macrocarpa* is relatively stable. In 2010, of the seven *D. asterophora* var. *macrocarpa* sub-EOs at Saucer Lake/Ralston Peak, two had increased, three were stable, one had decreased, and one was of unknown status (Figure 2). DRASM 1a (below Saucer Lake) had 43 plants in 2004, but could not be relocated in 2009 or 2010. The decline of this population may be due to its occurrence in marginal habitat with large amounts of litter. DRASM 1g (Ralston Peak), which was identified but not censused in 2004, could not be relocated in 2010. The exact location of this population is currently uncertain and the terrain quite hazardous; the population may be extant but impossible to access safely. Both of these populations (DRASM 1a and DRASM 1g) will be revisited in 2011. DRASM 1b was found to have declined between 2004 and 2009, but in 2010 over 1000 plants were again found; this discrepancy is probably due to differences in survey area and effort and will be verified in 2011.

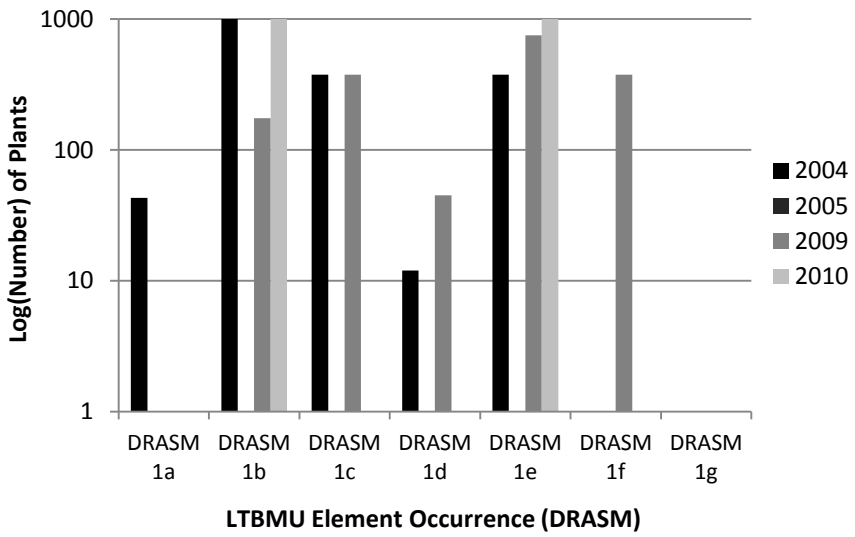


**Figure 2.** Census results of *Draba asterophora* var. *macrocarpa* populations on the LTBMU from survey years 2004, 2009, and 2010.

***Draba asterophora*: Long-term monitoring**

In 2010, permanent long-term monitoring plots were established at nine sub-element occurrences within all LTBMU *Draba asterophora* element occurrences (three *D. asterophora* var. *asterophora* occurrences and one *D. asterophora* var. *macrocarpa* occurrence) (Engelhardt & Gross 2011). The intent of the long-term monitoring is to more quantitatively and consistently determine the status and trend of the populations. Monitoring will also provide information on longevity of individual plants and plasticity of life stages, demographic structure and reproductive success, effects of annual climate patterns, and the characteristics of suitable habitat. This information can be combined to better interpret *D. asterophora* population changes. Results will be presented in a separate *Draba* report after a second year of baseline data is collected in 2011.

***Epilobium howellii***

*Epilobium howellii* populations are currently in decline (Figure 3). In 2010, no plants were observed at the five existing *E. howellii* sites. Four of these were first discovered in 2007 and had declined to zero plants in 2010. A population of 100 plants that was discovered in 2009 also had zero plants in 2010. While previously identified populations declined, a new population of approximately 300 plants was found in 2010. The cause for the widespread decline is unclear, and currently there is little known about the life history and long term persistence of this species. Observations by surveyors suggest that the species is a weak perennial and may act like an annual. Two visits will be made to each site in 2011 to improve the chances of observing the species at documented occurrences. Searches will also be expanded downstream and/or down-slope to areas where seed dispersal is most likely.

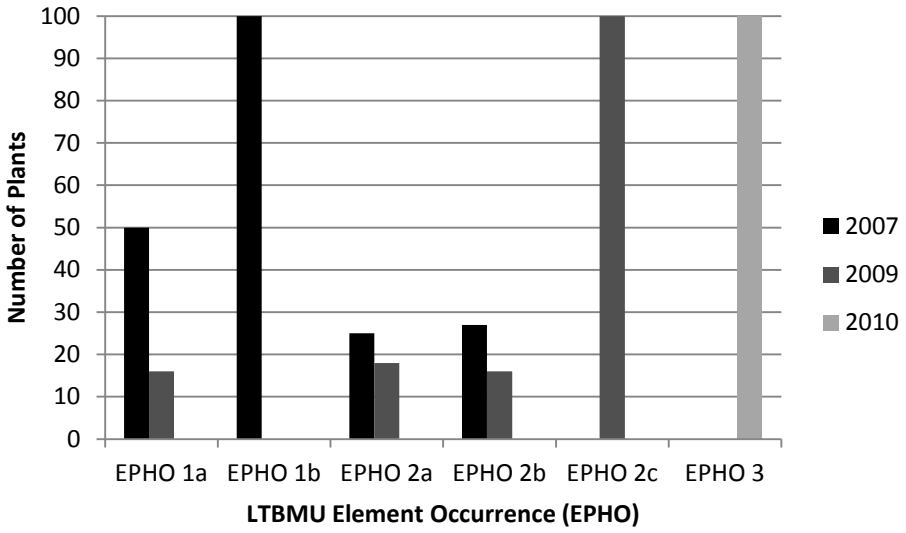


**Figure 3.** Census results of *Epilobium howellii* populations on the LTBMU from survey years 2007, 2009, and 2010.

***Helodium blandowii***

In the Lake Tahoe area, *Helodium blandowii* was first collected in 2004 at Tahoe Meadows along Ophir Creek on the Humboldt-Toiyabe National Forest. On the LTBMU, it was first found in 2009 in two locations: Grass Lake and a fen/wet meadow complex just north of Armstrong Pass. The Grass Lake population was still present during surveys conducted in 2010 and the extent of the population increased due to the discovery of additional *H. blandowii* patches. The Armstrong Pass population will be visited in 2011. The size of moss populations is currently assessed by estimating total area of the population and percent cover of the target species within that area. However, the often patchy distribution of moss species results in significant variation between years and observers. Currently, only presence/absence is used to assess population trend.

***Lewisia longipetala***

As of 2010, there are no consistent trends in *Lewisia longipetala* populations (Figure 4). Some populations are relatively stable, while others have declined. Of the four sub-

element occurrences at Dicks Lake, LELO1a is stable and LELO1d has increased. LELO1b and LELO1c have both declined substantially since the initial census in 2004, even though they increased slightly between 2009 and 2010. In 2010, LELO2a had fewer plants than at its peak in 2004, while LELO2b had increased slightly compared to 2009. The population near Triangle Lake/Keith's Dome (LELO3a and 3b) appears relatively stable.

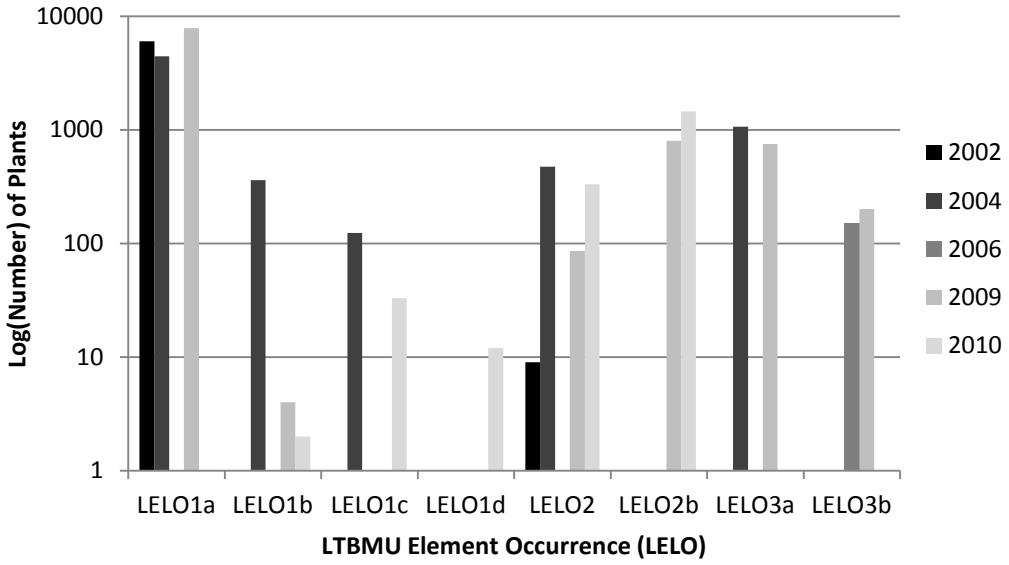


**Figure 4.** Number of plants observed at *Lewisia longipetala* populations from 2002 to 2010.

*Lewisia longipetala* grows in moist, rocky habitats directly below persistent snowfields, typically on north-facing, leeward slopes where snow accumulations are greatest. If climate change results in a decreasing snowpack, it is hypothesized that *L. longipetala* populations will decline. Consistent relationships between number of plants and snowfall accumulation/persistence have not yet been observed (Figures 4 & 5). However, census data from 2009 and 2010 suggest a positive relationship because many populations increased from 2009 to 2010, and the date that Snow-Water-Equivalent reached zero was nearly a full month later in 2010.

### ***Lewisia longipetala*: Long-term monitoring**

Permanent long-term monitoring plots were established at two LTBMU *L. longipetala* populations in 2009 and 2010 (Engelhardt & Gross 2011b). The intent of the long-term monitoring is to more quantitatively and consistently determine the status and trend of the populations. In addition, information on demographic structure and reproductive success, local snowfield patterns, annual climate patterns, and the associated plant community can be combined to better interpret population changes. Results will be presented in a separate *Lewisia* report after baseline data collection is complete.

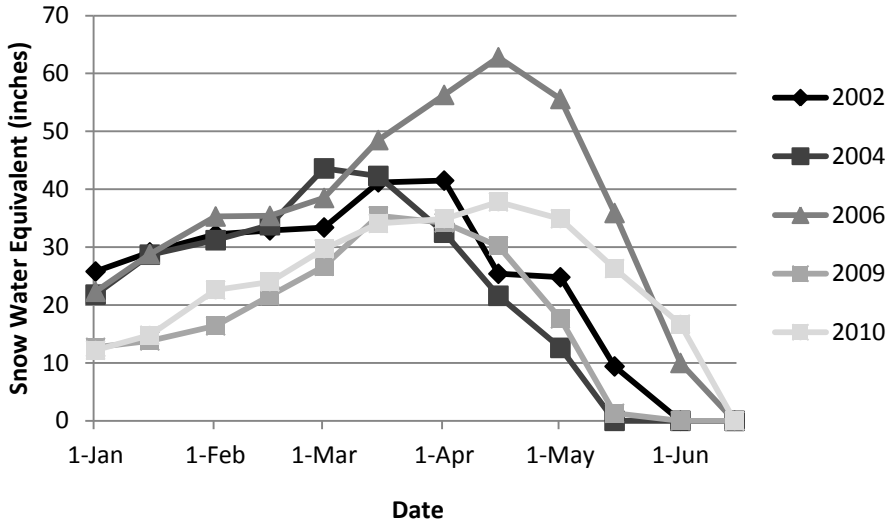


**Figure 5.** Snow water equivalent at the Echo Peak SNOTEL gauge (closest SNOTEL gauge to LTBMU LELO populations) during 2002, 2004, 2006, 2009, and 2010.

***Meesia triquetra***

Based on surveys completed in 2009 and 2010, 21 of 22 populations of *M. triquetra* were still present and one population was absent. The absent population is located just downstream of Incline Lake in the northeast Tahoe Basin. In 2010 the habitat no longer appeared suitable, potentially as a result of changes in Incline Lake discharge patterns. This population will be revisited in 2011. One additional population will be revisited in 2011 during the *Meesia* spp. long-term monitoring at the Angora Fen project (see below). As discussed previously, moss populations are currently assessed by estimating total area of the population and percent cover of the target species within that area. Because the patchy distribution of moss species results in significant temporal and observer variation in population extent, presence/absence is currently used to assess population trend.

***Meesia uliginosa***

*Meesia uliginosa* is currently known from two locations in the southern portion of the Lake Tahoe Basin, both of which were first observed in 2005. Based on surveys completed in 2009 and 2010, both populations of *M. uliginosa* were still present. The challenges of quantifying the extent of populations of this species are similar as those discussed for other moss species. One population will be revisited in 2011 during the *Meesia* spp. long-term monitoring at the Angora Fen project (see below).

***Meesia* spp.: Angora Fen Long-term monitoring**

In 2006, four permanent transects were established in the Angora Fen (South Lake Tahoe, CA) to quantitatively measure the percent cover of *Meesia triquetra* and *Meesia uliginosa* before and after construction and restoration activities at the site. The cover of *Meesia* spp. was measured in 2006, twice in 2007, and once in 2008. As of 2008, the cover of *M. triquetra* averaged across all four transects had not changed significantly since the initial survey. *Meesia uliginosa* was observed too infrequently to make

statistical comparisons, but was still present on the transects as of 2008. These transects will be resurveyed in 2011.

***Sphagnum* spp.**
Based on surveys completed in 2009 and 2010, all populations of *Sphagnum* spp. were extant. Five new occurrences of *Sphagnum* also were identified in 2010; all are located in the southern portion of the basin. Qualitative observations over several years suggest that *Sphagnum* species, which are often associated with fens, have been drying out. Several of the potential fen sites visited in 2009 could not be designated as fens due to hydrologic characteristics yet appeared as if historically they were a fen. *Sphagnum* spp. have the ability to promote fen development through the accumulation of peat and increased water holding capacity. As fens dry out, the accumulated layers of peat decompose and release $CO_2$ into the atmosphere. These sites should be monitored because *Sphagnum* spp. are responsive to changes in hydrology and temperature, and therefore could serve as an indicator of climate change. For this reason, the genus *Sphagnum* was added to the LTBMU target species list in 2008.

## 3. FUNGI DIVERSITY

In fall of 2008 three long-term fungi plots were established in the LTBMU by the Mycological Society of San Francisco. Following the Region 5 fungi monitoring protocol, the plots were established in modeled suitable habitat for sensitive fungi species. The plots are located at Fountain Place, Page Meadow, and Blackwood Canyon. At each location, fungi are searched for in two concentric circular plots that are 1/10th acre and 1/5th acre in size.

In 2009 no fungi were found in any of the three plots. In November 2010, a total of 37 fungi species were identified and verified from the plots. The Fountain Place plot yielded four species, the Page Meadow plot yielded 16 species, and the Blackwood Canyon plot yielded 29 species. Several species occurred in more than one plot, but observed fungi were not dominated by any particular species. Of the 37 species collected, two species are worthy of noting, *Mycena strobilinoides* (#3) had never been found in the Sierra Nevada prior to our collection, and the collection we made was the furthest south it has ever been collected. Another noteworthy collection was *Mycena vulgaris* (#2) which has only been collected four times EVER in North America (personal communication J.R. Blair 6/11/2011). Only one sensitive fungi species, *Dendrocollybia racemosa*, is known to occur in the Lake Tahoe Basin. However, it was not observed in the fungi plots in 2010. This species is currently only known on the LTBMU by an herbarium collection from Tahoe City.

## 4. SENSITIVE PLANT COMMUNITIES

### a. Fens
The LTBMU began participation in the Region 5 Fen Assessment in 2006. This effort was established to determine the presence and type of fens present on forests within the Sierra Nevada. A total of 135 potential fens have been assessed on LTBMU lands since

2006, twenty of which were visited and assessed in 2010. A total of 47 confirmed fens have been identified on LTBMU land, in the Caples Lake, Echo Lake, Emerald Bay, Freel Peak, Glenbrook, Mt. Rose, Rockbound Valley, and South Lake Tahoe USGS quadrangles (Figure 6). The fens range from 0.004 acres (SE of Angora Lakes stand) to 250 acres (Grass Lake) with an average of 4 acres. Data from fen assessments was entered into the regional fen geodatabase to aid in the regional conservation assessment. During the 2011 field season several more potential fen stands will be visited. These stands either need additional data to confirm if the site is a fen or wet meadow, or were identified based on the discovery of new populations of fen-associated plant species, such as *Sphagnum* spp. Once the remaining potential fen stands are assessed, a fen assessment/report will be completed that identifies conservation and restoration targets for fens managed by the LTBMU.

In addition to the LTBMU fen inventory, the California Native Plant Society (CNPS) was awarded a Southern Nevada Public Land Management Act (SNPLMA) science grant to refine vegetation classification and condition ranking systems for fens within the Lake Tahoe Basin. We worked with CNPS to monitor, map, and assess fens based on their plant community diversity and quality and to establish a system for quantitatively ranking fens based on existing methods. CNPS is using existing fen data as well as collecting additional monitoring data for at least 40 stands in order to sufficiently rank fen sites. CNPS also will analyze data from over 100 existing fen/montane wetland surveys to refine a vegetation classification system for fens in the region. The quantitative ranking of fen sites can then be used to identify high quality sites for protection and restoration. Results of this effort, including tools for further assessment, monitoring, and ranking of fens, were recently presented in Sikes et al. (2011).

**b. TRPA Rare Plant Community Threshold Sites**

Monitoring occurs regularly at rare plant community threshold sites identified by TRPA to serve as indicators of ecological health for similar rare plant communities across the Basin (TRPA 1998). The purpose in monitoring these sites is to document the trend and influence of disturbances and/or management practices on rare plant communities in order to develop more sustainable management strategies. The TRPA rare plant community threshold sites are: Grass Lake (fen), Hell Hole (fen), Osgood Swamp (fen), Pope Marsh (marsh), Taylor Creek (meadow), and Freel Peak (cushion plant community).

<u>Grass Lake</u>

Grass Lake was officially designated as a Forest Service Research Natural Area in 1991 in order to preserve a representative Sphagnum bog type in the Northern Sierra Nevada physiographic province of the Pacific Southwest Region. Grass Lake is the largest and best example of a Sphagnum bog (fen) in California. In addition, the Tahoe Regional Planning Agency has additional protection for Grass Lake under Vegetation Threshold V2 – Uncommon Plant Communities.

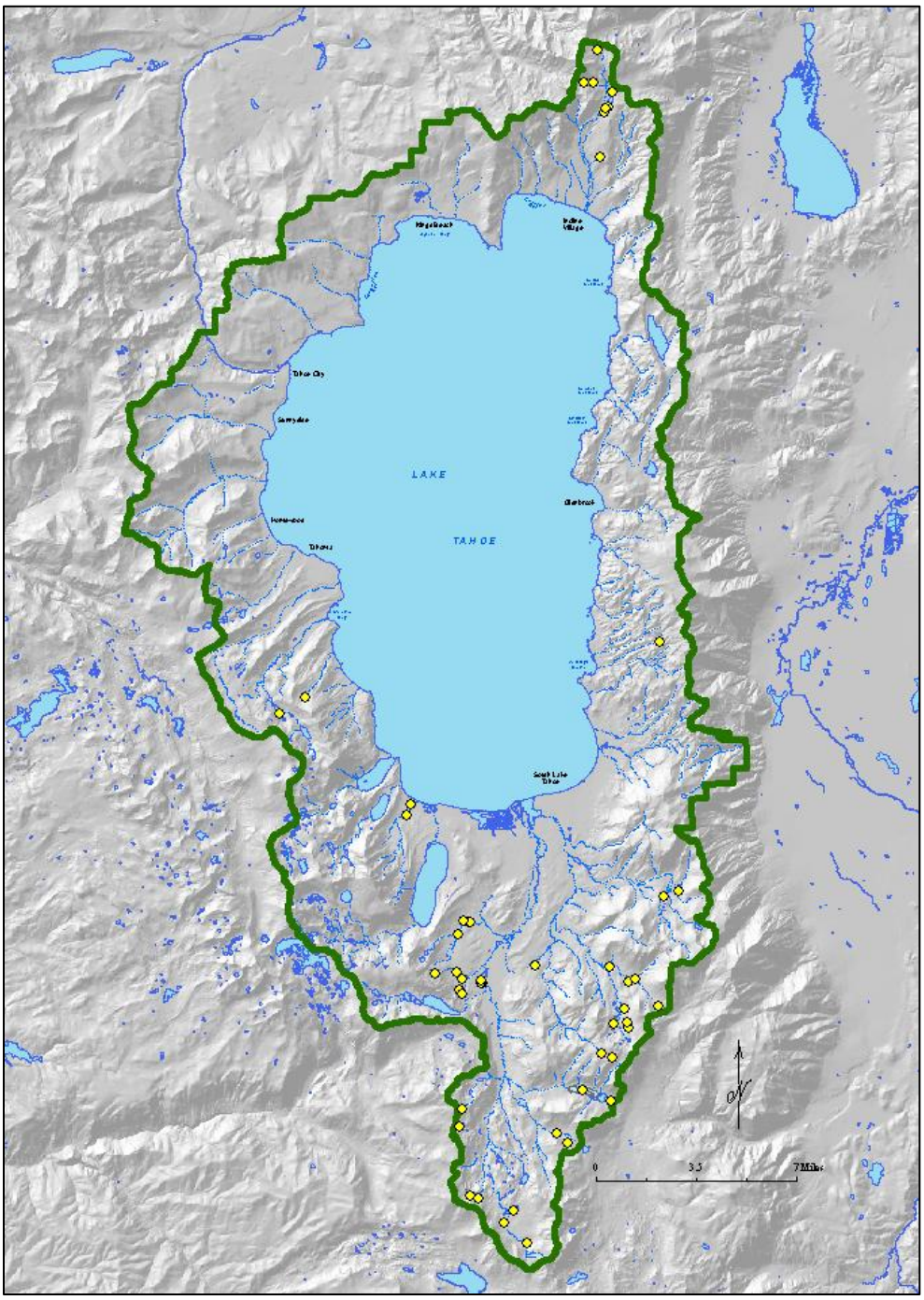


**Figure 6.** Locations of confirmed fens (as of 2010) on the Lake Tahoe Basin Management Unit.

The LTBMU initiated long-term vegetation monitoring at Grass Lake in 2004. Monitoring consists of three components: 1) three permanent meadow plots established following the USFS Region 5 Range Monitoring protocol (Weixelman et al 2003); 2) ten permanent repeat photo points; and 3) *Meesia triquetra* and *Sphagnum* spp. percent cover mapping. Hydrologic change is predicted to be the largest threat to this community,

which could be exaggerated by climate change. Bryophytes are good indicator organisms due to their relatively simple structures and their sensitivity to environmental change.

In 2010, monitoring at the Grass Lake Research Natural Area consisted of revisiting one of the three long-term meadow plots (Table 4) and monitoring the aerial cover of *M. triquetra* and *Sphagnum* spp. Aerial cover of these species was recorded using Braun-Blanquet cover classes (<5, 5-25, 25-50, 50-75, and 75-100) at 13 meter intervals along parallel transects throughout the entire 250 acre site. These two species were selected because Grass Lake is recognized as the largest and best example of a *Sphagnum* "bog" and *M. triquetra* is a Region 5 Forest Service sensitive species. Baseline data was collected in 2004 and 2005; repeat monitoring occurred in 2009 and 2010.

Geostatistical analysis from 2009 quantified the spatial patterns of population structure and inter-annual changes in the population structure. The area occupied by both *Sphagnum* and *Meesia* declined by approximately 30% between 2004/2005 and 2009. In addition, a 1-25% decline in percent cover was observed in areas occupied by these species. These rapid declines may be correlated with hydrologic variability; 2005 had greater peak discharge and base flow compared to 2004 and 2009. Data collected in 2010 has not yet been analyzed, but should provide additional information on the trend of these species given that the winter of 2010 was wetter and longer than in 2009.

Hell Hole, Osgood Swamp, Pope Marsh, Taylor Creek

These four threshold sites, all of which contain rare plant populations, each have at least one permanent range monitoring plot established following the protocol of Weixelman et al. (2003) (Table 4). Data collected in 2004 and 2005 established a baseline for future monitoring to classify the ecological status of each community into high, medium, and low condition classes. Community data analysis has not yet been completed; this will occur in 2011. In addition to the Hell Hole range monitoring plot, *Meesia*/*Sphagnum* monitoring similar to that at Grass Lake will be conducted in Hell Hole during 2011.

**Table 4**. Meadow monitoring history for TRPA threshold sites (Grass Lake, Hell Hole, Osgood Swamp, Pope Marsh, Taylor Creek). Initial monitoring date indicates when plots were established.

| Site | 2000 | 2004 | 2005 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|
| Grass Lake 1 | | X | | | X | |
| Grass Lake 2 | X | X | X | X | X | X |
| Grass Lake 3 | | X | X | | X | |
| Hell Hole 1 | X | X | X | | X | |
| Hell Hole 2 | | X | X | X | X | |
| Osgood Swamp | | X | X | | | |
| Pope 1 | | X | X | | X | |
| Pope 2 | | X | X | | X | |
| Taylor | | X | | | X | |

Freel Peak

In 2006, long-term monitoring plots were established on Freel Peak and two adjacent summits following the Global Observation Research Initiatives in Alpine Environments (GLORIA) protocol. The Pacific Southwest Research Station (PSW) has taken the lead in organizing monitoring efforts associated with GLORIA plots throughout the state of California. These plots are surveyed on a five-year rotation; the Freel Peak plots will be revisited in 2011. The Freel Peak plots are also located adjacent to known *Draba asterophora* var. *asterophora* populations, however no plants were found in the plots in 2006 even though the habitat is suitable for this species.

**c. Meadow Monitoring**

There are currently 63 long-term range monitoring plots in 36 meadows located throughout the Lake Tahoe Basin (Figure 7) including the plots at the four TRPA threshold plant community sites (Hell Hole, Osgood Swamp, Pope Marsh, Taylor Creek). These plots were established following the USFS Region 5 Range Monitoring protocol (Weixelman et al. 2003), and are designed to detect trends in ecological condition based on wetland indicator status, root length density, type of vegetative spread, life form, life history, and plant height. In the cases where these plots contain rare species, they are especially useful for quantitatively tracking species abundance. They also provide information on the environmental conditions necessary to support certain rare species. During 2010, ten meadow plots were revisited. These plots were experimentally treated with prescribed fire in 2008 and 2009 as part of a study of restoration of fire-adapted ecosystems. In addition, four new plots were established in 2010 at meadows that did not currently have monitoring plots (two at Page Meadow and two at the recently acquired Incline Lake property).

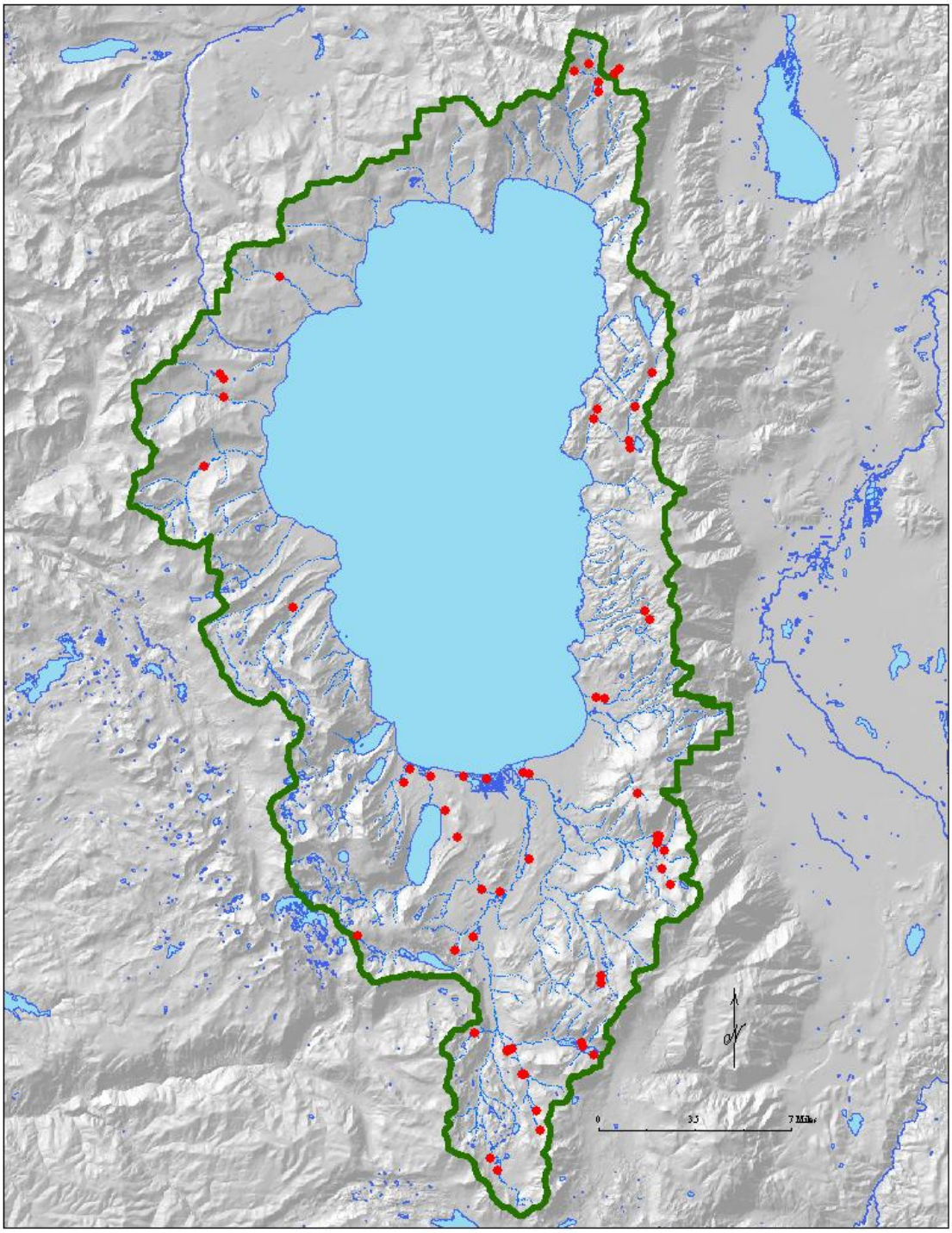


**Figure 7.** Locations of long-term range meadow monitoring plots in meadows on the Lake Tahoe Basin Management Unit.

## 5. LITERATURE CITED


Engelhardt, B.M. and Gross, S.E. 2011. Long-term monitoring plan: *Draba asterophora* var. *asterophora* & *Draba asterophora* var. *macrocarpa*. Lake Tahoe Basin Management Unit, USDA Forest Service, South Lake Tahoe, CA.

Engelhardt, B.M. and Gross, S.E. 2011b. Long-term monitoring plan: *Lewisia longipetala*. Lake Tahoe Basin Management Unit, USDA Forest Service, South Lake Tahoe, CA.

Engelhardt, B.M. and Gross, S.E. 2011c. Long-term monitoring plan: *Meesia triquetra* & *Sphagnum* spp. cover at Grass Lake Research Natural Area and Hell Hole. Lake Tahoe Basin Management Unit, USDA Forest Service, South Lake Tahoe, CA.

Harpel, J.A. 2008. Species Fact Sheet: Bruchia bolanderi, Updated February 2011. USDA Forest Service, Region 6, Portland, OR. Accessed at: http://www.fs.fed.us/r6/sfpnw/issssp/planning-documents/species-guides.shtml, August 2011.

Johnson-Groh, C. L. 1997. Field surveys for *Botrychium gallicomontanum* and phenology of *Botrychium mormo* in Minnesota. Report to the Minnesota Dept. Nat. Resources, St. Paul, MN.

Johnson-Groh, C. L. 1998. Population demographics, underground ecology and phenology of *Botrychium mormo*. Pp. 103-108 *in* N. Berlin, P. Miller, J. Borovansky, U. S. Seal, and O. Byers, eds. *Population and habitat viability assessment (PHVA) for the goblin fern (Botrychium mormo) Final Report.* Conservation Biology Specialist Group, Apple Valley, MN.

Johnson-Groh, C. L. and D. R. Farrar. 1993. Population dynamics of prairie moonworts (*Botrychium* subgenus *Botrychium*) in Iowa and Minnesota (abstract). American Journal of Botany 80: 109 (Abstract).

Lesica, P. and K. Ahlenslager. 1996. Demography and life history of three sympatric species of Botrychium subg. *Botrychium* in Waterton Lakes National Park, Alberta. Canadian Journal of Botany 74: 538-543.

Montgomery, J.D. 1990. Survivorship and predation changes in five populations of *Botrychium dissectum* in Eastern Pennsylvania. American Fern Journal 80: 173-182.

Muller, S. 1992. The impact of a drought in spring on the sporulation of *Botrychium matricariifolium* (Retz) A. Br. in the Bitcherland (Northern Vosges, France). Acta Oecologica 13: 335-343.

Muller, S. 1993. Population dynamics in *Botrychium matricariifolium* in Bitcherland (northern Vosges Mountains, France). Belgian Journal of Botany 126: 13-19.

NatureServe. 2004. A Habitat-Based Strategy for Delimiting Plant Element Occurrences: Guidance from the 2004 Working Group, October 2004. NatureServe, Arlington, VA. Accessed at http://www.natureserve.org/library/deliminting_plant_eos_Oct_2004.pdf, August 2011.

Sikes, K., Roach, D., Evans, J., and Gross, S. 2011. Plant Community Characterization and Ranking of Fens in the Lake Tahoe Basin, California and Nevada. California Native Plant Society, Vegetation Program, Sacramento, CA, and Lake Tahoe Basin Management Unit, USDA Forest Service, South Lake Tahoe, CA.

Tahoe Regional Planning Agency. 1998. Regional Plan for the Lake Tahoe Basin: Code of Ordinances. Section IX. Resource Management Provisions, Chapter 75: Sensitive and Uncommon Plant Protection and Fire Hazard Reduction.

USDA Forest Service. 1988. Land Resource Management Plan, Lake Tahoe Basin Management Unit, USDA Forest Service, South Lake Tahoe, CA.

USDA Forest Service. 1995. Forest Service Manual (FSM). Title 2600 – Wildlife, Fish, and Sensitive Plant Habitat Management, Section 2670.22, Amendment No. 2600-95-7, Effective June 23, 1995. USDA Forest Service, Washington, D.C.

Weixelman, D., G. Bakker, and J.A. Fites. 2003. USFS Region 5 Range Monitoring Project 2003 Report. Unpublished Report. Adaptive Management Services, USDA Forest Service, Nevada City, CA.

## 6. APPENDICES

**Appendix 1**. List of LTBMU target plant species that are currently surveyed for and monitored when a population is known from the forest.

| Species | Common Name | Current Status | Known on LBTMU |
|---|---|---|---|
| *Arabis rectissima* v. *simulans* | Washoe tall rockcress, Bristlyleaf rockcress | LTBMU Target Species | Y |
| *Arabis rigidissima* v. *demota* | Galena Creek rockcress | Sensitive | Y |
| *Arabis tiehmii* | Tiehm's rockcress | Sensitive | N |
| *Botrychium ascendens* | Upswept moonwort | Sensitive | Y |
| *Botrychium crenulatum* | Scalloped moonwort | Sensitive | Y |
| *Botrychium lineare* | Slender moonwort | Sensitive | N |
| *Botrychium lunaria* | moonwort | Sensitive | N |
| *Botrychium minganense* | Mingan moonwort | Sensitive | Y |
| *Botrychium montanum* | Western goblin | Sensitive | Y |
| *Bruchia bolanderi* | Bolander's candlemoss | Sensitive | Y |
| *Chaenactis douglassii* v. *alpina* | Alpine pincushion | LTBMU Target Species | Unknown |
| *Claytonia megarhiza* | Alpine spring-beauty | LTBMU Target Species | Y |
| *Dendrocollybia racemosa* | Branched collybia | Sensitive | Y* |
| *Draba asterophora* v. *asterophora* | Tahoe draba | Sensitive | Y |
| *Draba asterophora* v. *macrocarpa* | Cup Lake draba | Sensitive | Y |
| *Epilobium howellii* | Subalpine fireweed | Sensitive | Y |
| *Epilobium palustre* | Marsh willowherb | LTBMU Target Species | Y* |
| *Erigeron miser* | Starved daisy | Sensitive | N |
| *Eriogonum luteolum v. saltuarium* | Golden carpet buckwheat | LTBMU Target Species | N |

| Species | Common Name | Current Status | Known on LBTMU |
|---|---|---|---|
| *Eriogonum umbellatum* v. *torreyanum* | Torrey's or Donner Pass buckwheat | Sensitive | N |
| *Glyceria grandis* | American mannagrass | LTBMU Target Species | N |
| *Helodium blandowii* | Blandow's bogmoss | Sensitive | Y |
| *Hulsea brevifolia* | Short-leaved hulsea | Sensitive | N |
| *Lewisia kelloggii ssp. hutchisonii* | Kellogg's lewisia | Sensitive | N |
| *Lewisia kelloggii ssp. kelloggii* | Kellogg's lewisia | Sensitive | N |
| *Lewisia longipetala* | Long-petaled lewisia | Sensitive | Y |
| *Meesia longiseta* | Meesia moss | LTBMU Target Species | N |
| *Meesia triquetra* | Three-ranked humpmoss | Sensitive | Y |
| *Meesia uliginosa* | Broad-nerved humpmoss | Sensitive | Y |
| *Myurella julacea* | Myurella moss | LTBMU Target Species | N |
| *Orthotrichum praemorsum* | Orthotrichum moss | LTBMU Target Species | Y* Accession# JRS22039 |
| *Orthotrichum shevockii* | Shevock's bristle-moss | LTBMU Target Species | Y |
| *Orthotrichum spjutii* | Spjut's bristle-moss | LTBMU Target Species | N |
| *Peltigera hydrothyria* | Veined water lichen | Sensitive | Y |
| *Pohlia tundrae* | Tundrae pohlia moss | LTBMU Target Species | Y* Accession# JRS22659 |
| *Potamogeton epihydrus ssp. nuttallii* | Nuttalls pondweed | LTBMU Target Species | Y* |
| *Rhamnus alnifolia* | Alderleaf buckthorn | LTBMU Target Species | Y* |
| *Rorippa subumbellata* | Tahoe yellow cress | Sensitive, Candidate | Y |

| Species | Common Name | Current Status | Known on LBTMU |
|---|---|---|---|
| *Schoenoplectus subterminalis* | Swaying bulrush | LTBMU Target Species | Y* |
| *Scutellaria galericulata* | Marsh skullcap | LTBMU Target Species | Y |
| *Senecio hydrophiloides* | Sweet marsh ragwort | LTBMU Target Species | Y* |
| *Sphagnum* spp. | Sphagnum moss | LTBMU Target Species | Y |
| *Stuckenia (Potamogeton) filiformis* | Slender-leaved pondweed | LTBMU Target Species | Y* |

*Known from herbarium or text records; the LTBMU staff does not currently have exact location information for these species and is therefore not tracking these populations.