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# The Lichen Flora of the Spring Mountains, Humboldt-Toiyabe National Forest, Nevada, USA

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**Abstract**: 124 lichen species in 48 genera are reported for the Spring Mountains, Clark and Nye Counties, Nevada. The Spring Mountains are a sky island mountain range in the Mojave Desert located approximately 25 km northwest of Las Vegas. This species list includes 58% of the 217 species in 68 genera reported to date for the Mojave Desert. This survey was based on extensive collections made between 1997 and 2007 as part of an air quality bio-monitoring program and baseline established in the Spring Mountains, Humboldt-Toiyabe National Forest. This report represents a major contribution to our understanding of the lichen flora of Nevada in particular and the Mojave Desert in general.

**Key words:** Air quality, bio-monitoring, lichens, Mojave Desert, floristic survey, microhabitat, Spring Mountains, Las Vegas, air pollution, species diversity.

**Introduction:** Over a ten year period, a lichen air quality bio-monitoring program was established in the Spring Mountains, Humboldt Toiyabe National Forest. A total of fifteen study sites, distributed across the mountain range, were collected between 1997 and 2007 (St. Clair et al., 2007) (Figure 1). The Spring Mountains are located 25 km northwest of downtown Las Vegas, the largest population center in Southern Nevada. The bio-monitoring program was established to specifically monitor potential air pollution-related effects from the Las Vegas metropolitan area on the Spring Mountains National Recreation Area. This ten year project produced a valuable collection of specimens documenting the occurrence and distribution of lichen species in the Spring Mountains.

Hasse (1910, 1913) published the first report of lichens from the Mojave Desert as part of his survey of the lichen flora of Southern California. More recently, lichen studies by various researchers, across the range of Mojave Desert sub-habitats, have been completed providing a much broader sense of lichen distribution in the Mojave Desert (Figure 2).

Beyer and St. Clair (2004) reported 3 species in 3 genera from the Spring Mountains; these taxa are also included in the Spring Mountains lichen flora generated from the St. Clair air quality bio-monitoring collections. In 1999, Doell reported 63 species in 35 genera from the Sweeney Granite Mountains Desert Research Center, in the southwestern Mojave Desert, San Bernardino County, California (Figure 2). A more recent survey of the lichens of the Granite Mountains and Sweeney Granite Mountain Desert Research Center, reported 75 species in 40 genera; as well as several lichenicolous and one lignicolous fungi (Knudsen & Werth, 2008) (Figure 2). A survey of the lichens in the Eureka Peak area of Joshua Tree National Park, Riverside and San Bernardino Counties, California, added 35 species in 25 genera to a working checklist of over 70 species, 12 of which were found only on Eureka Peak (Knudsen & La Doux, 2006) (Figure 2). Also in the same study of Joshua Tree National Park, two lichenicolous fungi on new hosts, and one new lichenicolous fungus for California were reported (Knudsen & La Doux, 2006).

In a survey of the southwestern Mojave Desert at Keys Ranch, Joshua Tree National Park, San Bernardino County, California, 47 species in 34 genera were reported; with four species new to California (Knudsen & La Doux, 2005) (Figure 2). A smaller survey of lichens from several sites near Black Rock Road in northwestern Arizona, reported 43 species in 25 genera with two previously unreported taxa from a gypsiferous soil crust site (Jackson et al., 2005) (Figure 2). Finally a 2002 study of selected sites in the Mojave National Preserve in California reported 40 species in 24 genera (Knight et al., 2002) (Figure 2).

Interest has also increased in the biological soil crusts of the Mojave Desert, with several papers published since 2001. Johansen et al. (2001) noted that biological soil crusts in the Mojave Desert are generally not as species rich nor as well developed as crust communities in the Great Basin and Colorado Plateau. This pattern further emphasizes the fact that species diversity and structural development of arid land soil crust communities varies within the context of the environmental parameters which define each biogeographical region. Johansen et al. (2001) also indicated, based on a survey of 26 sites in and around Fort Irwin National Training Center (Figure 2), that large portions of this area lacked well developed soil crust communities which they attributed generally to the activity of off-road military vehicles. Belnap (2002) examined the impact of off-road vehicles on nitrogen cycles associated with biological soil crusts in various U.S. deserts including the Mojave Desert. Belnap and Warren (2002) studied recovery rates of biological soil crusts at sites in the Chemehuevi Valley, in the Mojave Desert, damaged by WW II

military training exercises conducted more than 65 years ago. They suggested that reestablishment of the lichen component of soil crusts is extremely slow, with full recovery potentially taking up to 2,000 years in some places due to the slow growth rate of the squamulose lichen *Placidium squamulosum*. Finally, in the Mojave Desert Williams (2011) studied the role biological processes associated with tall moss-lichen pinnacled crusts play in the formation of a vesicular A horizon (or Av horizon) and showed that biological soil crusts trap windblown dust, which along with the biological material goes through expansion and contraction via alternating hydration/ desiccation, and freeze/thaw cycles. The physical movements cause cracks and fissures that further trap aeolian deposits which, along with dissolution and recrystallization of authigenic minerals such as calcium carbonate, lead to the formation of a fine grained, vesicular A horizon (Williams, 2011).

**Materials and Methods**

Lichens were sampled from all habitats and substrates; including: soil, mosses/detritus, rocks, bark, and lignum. All collections have been curated and accessioned into the Herbarium of Nonvascular Cryptogams, in the M.L. Bean Life Science Museum, at Brigham Young University, Provo, Utah. Species identifications were made using standard chemical and microscopic techniques. Spot tests were used to identify basic thallus chemistry (Vitikainen, 2001, Orange, 2001). Thin layer chromatography (TLC) was performed on some specimens, and provided a more detailed look at lichen secondary chemistry. In addition, a short/long wavelength UV cabinet was used to more thoroughly characterize UV+ chemicals**.** Microscopic examination of fruiting body structures, including documentation of basic ascocarp features as well as the size, color, and number of ascospores per ascus, were used to finalize species identifications. The species descriptions in *Lichen Flora of the Greater Sonoran Desert Region* (Nash et al., 2002, 2004, and 2007) also provided valuable information. Nomenclature was based on the current version of The North American Lichen Checklist by T.L. Esslinger (2011).

***Study Area***

The Spring Mountains, located in southern Nevada, are so named for the many natural springs in the area. Ironically, much of Nevada overlays a large groundwater system, the Paleozoic carbonate aquifer (Osborn et al., 2008) and snow melt runoff from the Spring Mountains provides significant recharge to this aquifer (Osborn et al., 2008). The Spring Mountains are considered a sky island system. The range is approximately 90 km long from the NW to the SE corner. Elevation ranges from 1,371 m (4,498 feet) at the eastern base, to 3,632 m (11,916 feet) at the top of Mount Charleston (USDA 1). The formal boundary of the Spring Mountains National Recreation Area encompasses 127,880 hectares (USDA 1). The Spring Mountains, in the rain shadow of the Sierra Nevada Mountains, have an average annual precipitation of 51 cm/year at the crest of the range, (compared to Las Vegas at 10 cm/yr) (USDA 1). The mountain range includes 18,000 acres of bristlecone pines, the largest population in the Intermountain West. The plant community also includes several endemic species (USDA 1).

The Spring Mountains are a north-south oriented block faulted range divided by valleys and are partially located in the Great Basin Province (Wilson, 1991). The Great Basin, sandwiched between the Sierra Nevada Mountains on the west and the Wasatch Mountains on the east, encompasses approximately 200,000 square miles of internally draining watershed (USGS 1). The Spring Mountains were formed during an uplift of the Great Basin that began millions of years ago. The NE slope of the mountain range drains towards Las Vegas and the Lake Meade watershed, which eventually drains into the Colorado River, while the SW slope of the range

drains towards the Pahrump Valley in the Great Basin (USDA 3). The mountains themselves are made up of sedimentary rocks; some from the Precambrian and Mesozoic periods, while most are Paleozoic marine sedimentary rocks (Wilson, 1991).

***Collection Sites***

A total of fifteen air quality bio-monitoring reference or collection sites (Figure 1) were established in the Spring Mountains, Humboldt-Toiyabe National Forest during the 1997, 1999 – 2002 and 2004-2007 field seasons (St. Clair, 1997-2007, unpublished, St. Clair et al., 2007). Vascular plant nomenclature follows Welsh et al., 2008 and the USDA Plants Database (USDA 2). All GPS readings are reported as NAD 83 values.

Site 1. **Deer Creek Campground, Clark County**, off of Nevada State Road # 158, 19 August 1997. GPS reading: 36° 18.460´ north latitude; 115° 37.649´ west longitude. Elevation: 2,500 m (8,202 feet). Common vascular plants: *Populus tremuloides, Pinus ponderosa, Abies concolor, Juniperus scopulorum, Acer glabrum, Pinus longaeva, Thalictrum fendleri, Ribes* sp., *Sambucus* sp., *Cercocarpus* sp., *Symphoricarpos* sp.

Site 2. Along **Little Falls Trail, Kyle Canyon, Clark County**, 20 August 1997. GPS reading: 36° 15.442´ north latitude, 115° 39.137´ west longitude. Elevation: 2,650 m (8,694 feet). Common vascular plants: *Acer glabrum, Angelica scabrida, Populus tremuloides, Abies concolor, Aloysia wrightii, Pinus ponderosa, Mahonia repens, Quercus gambelii, Cercocarpus intricatus, Glossopetalon clokeyi, Sambucus* sp., *Ribes* sp.

Site 3. Along trail to **Mary Jane Falls, Clark County**, 6 July 1999. GPS reading: 36° 16.525´ north latitude; 115° 39.490´ west longitude. Elevation: 2,225 m (7,300 feet). Common vascular plants: *Pinus flexilis, Pinus ponderosa, Abies concolor, Sambucus* sp., *Ribes* sp., *Acer glabrum, Cercocarpus intricatus, Populus tremuloides, Symphoricarpos* sp.

Site 4. **Clark Canyon, Clark County**, 7 July 1999. GPS reading: 36° 19.298´ north latitude; 115° 45.139´ west longitude. Elevation: 1,950 m (6,398 feet). Common vascular plants: *Pinus ponderosa, Abies concolor, Juniperus osteosperma, Pinus monophylla, Cercocarpus intricatus, Symphoricarpos* sp., *Ribes* sp., *Sambucus* sp., *Purshia stansburiana, Ericameria nauseosus*, *Artemisia tridentata, Amelanchier alnifolia, Arctostaphylos* sp., *Ephedra nevadensis, Acer glabrum.*

Site 5. **Wallace Canyon, Clark County**, 7 July & 27 August 1999. GPS reading: 36° 17.124′ north latitude; 115° 43.693´ west longitude. Elevation: 2,408 m (7,900 feet). Common vascular plants: *Pinus ponderosa, Abies concolor, Juniperus scopulorum, Acer glabrum, Cercocarpus intricatus, Ribes* sp., *Sambucus* sp., *Ericameria nauseosus, Symphoricarpos* sp., *Arctostaphylos* sp.

Site 6. **Carpenter Canyon, Clark County**, 8 July & 27 August 1999. GPS reading: 36° 14.483´ north latitude; 115° 43.882´ west longitude. Elevation: 2,050 m (6,726 feet). Common vascular plants: *Pinus ponderosa, Pinus monophylla, Abies concolor, Juniperus osteosperma, Juniperus scopulorum, Forestiera pubescens, Quercus gambelii, Prunus virginiana, Purshia stansburiana, Artemisia tridentata, Cercocarpus intricatus, Ericameria nauseosus, Acer glabrum, Salix lutea, Garrya flavescens, Ephedra* sp.

Site 7. **Mack's Canyon, Clark County**, 26 August 1999. GPS reading: 36° 21.660´ north latitude; 115° 40.286´ west longitude. Elevation: 2,316 m (7,600 feet). Common vascular plants: *Pinus ponderosa, Abies concolor, Juniperus osteosperma, Juniperus scopulorum, Acer glabrum, Tetradymia canescens, Cercocarpus intricatus, Purshia tridentata, Sambucus* sp.,

*Ericameria nauseosus*, *Symphoricarpos* sp., *Opuntia* sp.

Site 8. **Wheeler Pass, Clark County**, 2 August 2000. GPS reading: 36° 23.450´ north latitude; 115° 47.805´ west longitude. Elevation: 2,347 m (7,700 feet). Common vascular plants: *Cercocarpus intricatus, Cercocarpus ledifolius, Amelanchier utahensis, Pinus monophylla, Quercus gambelii, Pinus ponderosa, Artemisia tridentata, Yucca* sp., *Ephedra* sp., *Symphoricarpos* sp., *Opuntia* sp., and *Arctostaphylos* sp.

Site 9. Vicinity **Bonanza Peak Trailhead and Whiskey Spring, Clark County**, 3 August 2000. GPS reading: 36° 22.966´ north latitude; 115° 44.458´ west longitude. Elevation: 2,286 m (7,500 feet). Common vascular plants: *Pinus ponderosa, Pinus monophylla, Cercocarpus intricatus, Abies concolor, Quercus gambelii, Artemisia tridentata, Amelanchier utahensis, Ericameria nauseosus, Ribes* sp.*, Opuntia* sp.*, Sambucus sp., Symphoricarpos* sp.

Site 10. Vicinity **Mud Springs, Clark County**, 3 August 2000. GPS reading: 36° 22.322´ north latitude; 115° 40.966´ west longitude. Elevation: 2,256 m (7,401 feet). Common vascular plants: *Pinus monophylla, Pinus ponderosa, Juniperus osteosperma, Juniperus scopulorum, Purshia tridentata, Purshia mexicana, Cercocarpus intricatus, Populus angustifolia, Amelanchier alnifolia, Tetradymia canescens, Abies concolor, Rosa woodsii, Artemisia tridentata, Forestiera pubescens, Ribes* sp., *Symphoricarpos* sp.

Site 11. Trail to **Griffith Peak, Clark County**, 3 September 2001. GPS reading: 36° 13.206´ north latitude; 115° 35.893´ west longitude. Elevation: 2,591 m (8,500 feet). Common vascular plants: *Abies concolor, Amelanchier utahensis, Arctostaphylos pungens, Artemisia tridentata, Ceanothus martinii, Cercocarpus ledifolius* var. *intermontanus, Ericameria nauseosus, Ephedra viridis, Eriogonum* sp., *Garrya flavescens, Petradoria pumila* var. *pumila, Physaria chambersii, Pinus monophylla, Quercus gambelii, Ribes cereum* var. *cereum, Symphoricarpos oreophilus, Tetradymia canescens, Heliomeris multiflora* var. *nevadensis*.

Site 12. Vicinity **Trout Canyon, Clark County**, 12 September 2001. GPS reading: 36° 11.053´ north latitude; 115° 40.489´ west longitude. Elevation: 2,591 m (8,500 feet). Common vascular plants: *Pinus monophylla, Juniperus osteosperma, Artemisia tridentata, Ephedra viridis, Amelanchier utahensis, Garrya flavescens, Opuntia phaeacantha, Festuca rubra, Tetradymia canescens, Quercus gambelii, Purshia stansburiana*.

Site 13. Vicinity **Big Timber Springs, Nye County**, 2 July 2002. GPS reading: 36° 27.713´ north latitude; 115° 55.908´ west longitude. Elevation: 1,846 m (6,056 feet). Common vascular plants: *Pinus monophylla, Juniperus osteosperma, Artemisia tridentata, Purshia stansburiana, Ephedra* sp.*, Tetradymia* sp.*, Yucca* spp.*, Opuntia* sp.*, Purshia tridentata*.

Site 14. **Crystal Spring Canyon, Nye County**, 23 November 2002. GPS reading: 36° 25.607´ north latitude; 115° 58.434´ west longitude. Elevation: 1,600 m (5,249 feet). Common vascular plants: *Pinus monophylla, Yucca* spp., *Ephedra* sp.*, Juniperus osteosperma, Opuntia* sp.*, Purshia tridentata, Eriogonum* sp.*, Artemisia tridentata, Ericameria nauseosus, Coleogyne ramosissima*.

Site 15. **Bristlecone Loop Trail, Clark County**, 4 July 2004. GPS reading: 36° 18.618´ north latitude; 115° 40.629´ west longitude. Elevation: 2,642 m (8,668 feet). Common vascular plants: *Pinus ponderosa, Pinus longaeva, Abies concolor, Populus tremuloides, Acer glabrum, Symphoricarpos longiflorus, Ribes velutinum, Ericameria nauseosus, Rosa woodsii,* and *Sambucus nigra* ssp. *caerulea*.

**Results**

To date, 123 lichen species in 48 genera have been identified from the 15 collection sites in the Spring Mountains, Humboldt-Toiyabe National Forest (Tables 1 & 2). The flora is dominated by crustose species (55.3%), followed by foliose (35%), squamulose (8.1%), and fruticose species (1.6%). Lichen species were collected from all habitats and substrates: rock, bark/lignum, soil, moss/detritus. The following substrate percentages represent the predominant substrate: rock (54.5 %); bark/lignum (31.7%); soil (8.1%); and moss/detritus 1.6%). In addition, the following mixed results were noted: 4% of the species occurred evenly distributed over various combinations of substrates (either bark/rock, rock/soil, or moss/bark. This occurred so infrequently, or with such low numbers of specimens collected, that no reliable conclusions can be inferred other than some species occur on more than one substrate.

***The following genera are reported in this study***

*Acarospora, 6 species*
*Adelolecia, 1 species*
*Anaptychia, 1 species*
*Aspicilia, 3 species*
*Buellia, 2 species*
*Caloplaca, 7 species*
*Candelariella, 6 species*
*Carbonea, 1 species*
*Catapyrenium, 1 species*
*Circinaria, 3 species*
*Cladonia, 1 species*
*Collema, 5 species*
*Dermatocarpon, 4 species*
*Dimelaena, 1 species*
*Hyperphyscia, 1 species*
*Lecania, 1 species*
*Lecanora, 16 species*
*Lecidea, 2 species*
*Lecidella, 3 species*
*Lichinella, 1 species*
*Lobothallia, 2 species*
*Melanelia, 1 species*
*Melanohalea, 4 species*
*Parmeliopsis, 1 species*
*Peltigera, 1 species*
*Phaeophyscia, 3 species*
*Physcia, 7 species*
*Physciella, 1 species*
*Physconia, 2 species*
*Placidium, 1 species*
*Placopyrenium, 1 species*
*Pleopsidium, 1 species*
*Polysporina, 1 species*
*Psora, 3 species*
*Rhizoplaca, 3 species*
*Rinodina, 5 species*
*Sarcogyne, 3 species*
*Seirophora, 1 species*
*Solorina, 1 species*
*Staurothele, 3 species*
*Strangospora, 1 species*
*Toninia, 2 species*
*Umbilicaria, 1 species*
*Usnea, 2 species*
*Xanthomendoza, 2 species*
*Xanthoparmelia, 2 species*
*Xanthoria, 2 species*
*Xylographa, 1 species*

**Discussions and Conclusions:** The lichen flora of the Spring Mountains is locally diverse and well developed. With 123 species in 48 genera it is the most diverse lichen flora reported for the Mojave Desert bioregion and represents 56.9% of the 216 species in 68 genera reported for the Mojave Desert system. This study represents a significant contribution to our understanding of the lichen flora of this largely unexamined region of western North America. The “Sonoran Project” (Nash et al., 2002, 2004, and 2007) is the most complete and broad ranging look at lichen communities in the western hemisphere, reporting more than 1,800 species in 280 genera. However, Nash understandably provided only limited information about the occurrence and distribution of lichen species in the Mojave Desert. A comparison between the Spring

Mountains and Sonoran lichen floras reveals that 90% of the lichen species reported for the Spring Mountains are also found in the Sonoran Desert. The total number of species for the Sonoran and Mojave deserts (1,800 and 216 respectively) shows that the Sonoran flora is much more diverse. However, due to general climatic differences, overall size, and habitat diversity and complexity, we predict that a more concentrated and thorough study of the lichen flora of the Mojave Desert will likely not yield species numbers approaching that which have been reported for the Sonoran Desert.

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**Table 1 –** Spring Mountains, distribution of lichen species by reference site with a 2-3 letter designation indicating the collection site, as follows: **BL** - Bristlecone Loop Trail, **BP** – Bonanza Peak and Whiskey Springs Trailhead, **CaC** – Carpenter Canyon, **CC** – Clark Canyon, **CS** – Crystal Springs Canyon, **DC** – Deer Creek Campground, **GP** – Griffiths Peak, **LF** – Little Falls, **MC** – Mack's Canyon, **MJ** – Mary Jane Falls, **MS** – Mud Springs, **TC** – Trout Canyon, **TS** – Big Timber Springs, **WC** – Wallace Canyon, **WP** - Wheeler Pass.

| **Genus/species** | **No. 1** | **No. 2** | **No. 3** | **No. 4** | **No. 5** | **No. 6** | **No. 7** | **No. 8** | **No. 9** | **No. 10** | **No. 11** | **No. 12** | **No. 13** | **No. 14** | **No. 15** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site acronyms** | **DC** | **LF** | **MJ** | **CC** | **WC** | **CaC** | **MC** | **WP** | **BP** | **MS** | **GP** | **TC** | **TS** | **CS** | **BL** |
| *Acarospora badiofusca* | | X | | | | | X | | X | | X | | | | |
| *Acarospora brouardii* | | | | | | | | | | | | | | X | |
| *Acarospora fuscata* | | | X | | | | | | | | X | | X | X | |
| *Acarospora glaucocarpa* | X | | | | | | | | | | | | | | |
| *Acarospora macrospora* | | | | X | | | | | | | | | | | |
| *Acarospora strigata* | | | | X | X | | | | | X | | X | | X | |
| *Adelolecia sonorae* | X | | | | | | | | | | | | | | |
| *Anaptychia elbursiana* | X | | | X | | | | | | | | | | | |
| *Aspicilia cinerea* | | | | | | X | X | | | | | | | | |
| *Aspicilia fumosa* | | | | | | X | | | | | | | | | |
| *Aspicilia verrucigera* | X | | | | | | | | | | | | | | |
| *Buellia badia* | | | | | | | | | | | | | X | | |
| *Buellia disciformis* | X | | X | | | | | | | | | | | | |
| *Caloplaca arenaria* | | | | | X | | | | | | X | X | X | | |
| *Caloplaca atroalba* | | X | X | | | | | | | | | | | | |
| *Caloplaca cerina* | | X | X | | | | | | | | X | | | | |
| *Caloplaca ferruginea* | | | X | | | | X | | | | | | | | |
| *Caloplaca fraudans* | | | | | X | | | | | | X | X | X | | |
| *Caloplaca saxicola* | | | | | | | X | | | X | | X | X | X | |
| *Caloplaca subsoluta* | | X | | | | | | | | | | | | | |
| *Candelariella antennaria* | | X | | | | X | X | | | X | X | X | X | X | |
| *Candelariella citrina* | | X | | | | | | | | | | | | | |

| **Genus/species** | **No. 1** | **No. 2** | **No. 3** | **No. 4** | **No. 5** | **No. 6** | **No. 7** | **No. 8** | **No. 9** | **No. 10** | **No. 11** | **No. 12** | **No. 13** | **No. 14** | **No. 15** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site acronyms** | **DC** | **LF** | **MJ** | **CC** | **WC** | **CaC** | **MC** | **WP** | **BP** | **MS** | **GP** | **TC** | **TS** | **CS** | **BL** |
| *Candelariella efflorescens* | | | | | | | | | | | | X | | | |
| *Candelariella rosulans* | | | | | X | | X | X | X | | | | | | |
| *Candelariella spraguei* | X | | | | | | | | | | | | | | |
| *Candelariella vitellina* | | | X | X | | | | | | | X | X | X | | |
| *Carbonea vorticosa* | | X | | | | | | | | | | | | | |
| *Catapyrenium squamellum* | X | | | | | | | | | | | | | | |
| *Circinaria arida* | | X | | | | | | X | | | | | | X | |
| *Circinaria calcarea* | | | | | | | | | | | X | | X | | |
| *Circinaria contorta* | X | X | | X | | | | | | | | | | | |
| *Cladonia cariosa* | Collected by Cheryl Beyer | | | | | | | | | | | | | | |
| *Collema callopismum* | | X | | | | | | | | | | | | | |
| *Collema crispum* | X | | X | X | | | X | | | | | | | | |
| *Collema cristatum* | X | | | | X | | X | | | | | X | | | |
| *Collema fuscovirens* | | | X | | | | X | | X | | X | X | X | | |
| *Collema polycarpon* | X | X | | X | | X | | | X | | | | | | |
| *Dermatocarpon lorenzianum* | | | X | | | | | | X | X | X | | | X | |
| *Dermatocarpon luridum* | Collected by Cheryl Beyer | | | | | | | | | | | | | | |
| *Dermatocarpon miniatum* | X | X | X | X | X | X | X | X | X | | X | X | X | X | |
| *Dermatocarpon vellereum* | | | | | | X | | | | | | | | | |
| *Dimelaena oreina* | | | | | | | | X | | | | | | | |
| *Hyperphyscia adglutinata* | | | | | | | | | | | | X | | | |
| *Lecania polycycla* | X | | | | | | | | | | | | | | |
| *Lecanora albellula* | | | | | X | X | | | | | | | | | |
| *Lecanora crenulata* | | | | | | | | | | X | | X | | | |
| *Lecanora densa* | | | | | | | | | | X | | | | | |
| *Lecanora dispersa* | X | | | X | | | | | | | | | | | |

| **Genus/species** | **No. 1** | **No. 2** | **No. 3** | **No. 4** | **No. 5** | **No. 6** | **No. 7** | **No. 8** | **No. 9** | **No. 10** | **No. 11** | **No. 12** | **No. 13** | **No. 14** | **No. 15** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site acronyms** | **DC** | **LF** | **MJ** | **CC** | **WC** | **CaC** | **MC** | **WP** | **BP** | **MS** | **GP** | **TC** | **TS** | **CS** | **BL** |
| *Lecanora flowersiana* | | | X | | | | | | | | | | | | |
| *Lecanora garovaglii* | | | | | | | | X | X | | | | | | |
| *Lecanora hagenii* | | X | | | X | | X | | | X | | | | | |
| *Lecanora meridionalis* | | | X | | | | | | | | | | | | |
| *Lecanora mughicola* | | | | | | | | | | X | | | X | | |
| *Lecanora muralis* | | | | | | | | | | | | X | | | |
| *Lecanora noedegelii* | | | | | | X | | | | | | | | | |
| *Lecanora oreinoides* | | | X | | | | | | | | | | | | |
| *Lecanora saligna* | | | | | | | | | | X | | | X | | |
| *Lecanora symmicta* | | | | | X | | | | | | X | | | | |
| *Lecanora valesiaca* | X | | | | | | X | | | | | | | | |
| *Lecanora varia* | | | X | | | | | | X | | | X | | | |
| *Lecidea laboriosa* | | | | | | | | X | | | | | | | |
| *Lecidea leprarioides* | | | | | | | X | | | | | X | | | |
| *Lecidella carpathica* | X | X | X | | | | | | X | X | | | | | |
| *Lecidella euphorea* | | | | | | X | | | | X | | | | | X |
| *Lecidella stigmatea* | X | | X | X | | X | X | | | | | | | | |
| *Lichinella nigritella* | | | | X | X | | | | | | X | X | | | |
| *Lobothallia alphoplaca* | | | | | | | | X | | | | | | | |
| *Lobothalia praeradiosa* | | | | | | | | | | | | | X | X | |
| *Melanelia tominii* | | | | | | | | X | | | | | | | |
| *Melanohalea elegantula* | X | | | | | X | | X | X | | | X | | | |
| *Melanohalea exasperatula* | | X | | | | | | X | | X | | X | | | X |
| *Melanohalea subelegantula* | | | | | | X | | | X | | | | | | |
| *Melanohalea subolivacea* | X | X | X | X | X | X | X | | X | X | X | X | | | X |
| *Parmeliopsis ambigua* | | X | | | | | | | | | | | | | |

| **Genus/species** | **No. 1** | **No. 2** | **No. 3** | **No. 4** | **No. 5** | **No. 6** | **No. 7** | **No. 8** | **No. 9** | **No. 10** | **No. 11** | **No. 12** | **No. 13** | **No. 14** | **No 15** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site acronyms** | **DC** | **LF** | **MJ** | **CC** | **WC** | **CaC** | **MC** | **WP** | **BP** | **MS** | **GP** | **TC** | **TS** | **CS** | **BL** |
| *Peltigera rufescens* | X | | | X | | | | | | | | | | | |
| *Phaeophyscia kairamoi* | | | | | | X | | | | | | | | | |
| *Phaeophyscia nigricans* | | | | | | X | | | | | | | X | X | |
| *Phaeophyscia sciastra* | X | | | | | | X | | | | | | | | |
| *Physcia adscendens* | | | | | | | | | | X | X | X | | | |
| *Physcia biziana* | | | | | | | X | X | | X | | | | | |
| *Physcia caesia* | X | | | X | | | X | X | | | | | | | |
| *Physcia dimidiata* | | | | | | | | | X | | | | | | |
| *Physcia dubia* | X | | | | X | | X | X | X | X | | X | | X | |
| *Physcia stellaris* | X | X | X | X | X | X | X | | X | X | X | X | X | | X |
| *Physcia tenella* | | | | | | | | | | X | | | | | |
| *Physciella chloantha* | X | X | | | | X | X | | | | X | | X | X | X |
| *Physconia elegantula* | | | | | | | X | | | | | | | | |
| *Physconia isidiigera* | X | | | | | | | | | | | | | | |
| *Placidium squamulosum* | | X | | | X | X | X | | | | | X | X | X | |
| *Placopyrenium stanfordii* | | | | | | | | | | | X | | | | |
| *Pleopsidium flavum* | | | | | | | | X | | | | | | | |
| *Polysporina urceolata* | X | | | | | | | | | | | | | | |
| *Psora cerebriformis* | | | | | | | | | | | | X | | | |
| *Psora himalayana* | | | | X | | | X | | | | | X | | | |
| *Psora tuckermanii* | X | X | X | X | X | X | X | | X | X | X | X | X | | |
| *Rhizoplaca chrysoleuca* | | | | | | | | X | | | | | | | |
| *Rhizoplaca melanophthalma* | | | | | | | | X | X | | | X | X | X | |
| *Rhizoplaca peltata* | | | | | | | | X | | | | | | | |
| *Rinodina capensis* | | | | | | | | | | X | | | | | |
| *Rinodina conradii* | | | | | | X | | | | | | | | | |

| **Genus/species** | **No. 1** | **No. 2** | **No. 3** | **No. 4** | **No. 5** | **No. 6** | **No. 7** | **No. 8** | **No. 9** | **No. 10** | **No. 11** | **No. 12** | **No. 13** | **No. 14** | **No. 15** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site acronyms** | **DC** | **LF** | **MJ** | **CC** | **WC** | **CaC** | **MC** | **WP** | **BP** | **MS** | **GP** | **TC** | **TS** | **CS** | **BL** |
| *Rinodina endospora* | | | | | | | | | | X | | | | | |
| *Rinodina lobulata* | X | | | | X | X | | | | | | | | | X |
| *Rinodina pyrina* | | | | | X | | X | | | | | | | | |
| *Sarcogyne regularis* | | X | | | | | | | | | X | | | | |
| *Sarcogyne similis* | | X | | | | | | | | | | | | | |
| *Seirophora contortuplicata* | | | | X | | | | | | | | | | | |
| *Solorina spongiosa* | Collected by Cheryl Beyer | | | | | | | | | | | | | | |
| *Staurothele areolata* | X | | X | X | X | X | X | | X | X | | X | | | |
| *Staurothele drummondii* | X | X | | | X | | | | | X | X | X | | | |
| *Staurothele polygonia* | | | | | | | | | | | X | | | | |
| *Strangospora microhaema* | | | | | X | X | X | | | | | | | | |
| *Tonina candida* | | | | X | | X | | | X | | | | | | |
| *Toninia sedifolia* | | | | | X | | X | | | | | | X | | |
| *Umbilicaria hyperborea* | | | | | | | | | | | | | | X | |
| *Usnea hirta* | | | | | | | | | | X | | | | | |
| *Usnea lapponica* | | | | | | | X | | | | | | | | |
| *Xanthomendoza fallax* | X | | | | | X | X | X | X | X | | X | | | |
| *Xanthomendoza montana* | X | X | X | X | X | X | X | | X | X | X | X | X | | X |
| *Xanthoparmelia cumberlandia* | | | | | | | | X | | | | | | | |
| *Xanthoparmelia mexicana* | | | | | | | | X | | | | | | X | |
| *Xanthoria elegans* | X | X | X | X | X | X | X | X | X | | X | X | X | X | |
| *Xanthoria sorediata* | X | | | | | | | | | | | | | | |
| *Xylographa parallela* | | X | | | | | | | | | | | | | |

**Table 2** – Spring Mountains lichen checklist, with herbarium numbers (preceded by "BRYC") followed by a 2-3 letter designation in parentheses indicating the collection site, as follows: **BL** - Bristlecone Loop Trail, **BP** – Bonanza Peak and Whiskey Springs Trailhead, **CaC** – Carpenter Canyon, **CC** – Clark Canyon, **CS** – Crystal Springs Canyon, **DC** – Deer Creek Campground, **GP** – Griffiths Peak, **LF** – Little Falls, **MC** – Mack's Canyon, **MJ** – Mary Jane Falls, **MS** – Mud Springs, **TC** – Trout Canyon, **TS** – Big Timber Springs, **WC** – Wallace Canyon, **WP** - Wheeler Pass. Substrate (**R**=rock; **B**=bark; **L**=lignum; **S**=soil; and **M**=moss. growth form (**C**=crustose; **Fo**=foliose; **Fr**=fruticose; and **S**=squamulose), and abundance (**R**=rare; **U**=uncommon; **C**=common; and **A**=abundant) information is also included.

| Genus/species | Author(s) | Sub-strate | Abun-dance | Growth Form | Voucher Numbers by Reference Site |
|---|---|---|---|---|---|
| *Acarospora badiofusca* | (Nyl.) Th. Fr. | R | UC | C | BRYC-35538 (**LF**), BRYC-37549b (**MC**), BRYC-38224 (**BP**), BRYC-39090a (**GP**) |
| *Acarospora brouardii* | B. de Lesd. | R | R | S | BRYC-39704 (**CS**) |
| *Acarospora fuscata* | (Schrader) Arnold | R | R | C | BRYC-37261 (**MJ**), BRYC-39084 (**GP**), BRYC-39156 (**TS**), BRYC-39179 (**TS**), BRYC-39719 (**CS**) |
| *Acarospora glaucocarpa* | (Ach.) Körber | R | R | S | BRYC-35500 (**DC**) |
| *Acarospora macrospora* | (Hepp) A. Massal. ex Bagl. | R | R | C | BRYC-37301 (**CC**) |
| *Acarospora strigata* | (Nyl.) Jatta | R | UC | C | BRYC-37304 (**CC**), BRYC-37567 (**WC**), BRYC-38247 (**MS**), BRYC-39138a (**TC**), BRYC-39699 (**CS**), BRYC-39714 (**CS**) |
| *Adelolecia sonorae* | Hertel | R | R | C | BRYC-35530 (**DC**) |
| *Anaptychia elbursiana* | (Szatala) Poelt | R, S | R | Fo | BRYC-35513 (**DC**), BRYC-37305 (**CC**) |
| *Aspicilia cinerea* | (L.) Körber | R | R | C | BRYC-37586 (**CaC**), BRYC-37553 (**MC**) |
| *Aspicilia fumosa* | Owe-Larss. & A. Nordin | R | R | C | BRYC-37592 (**CaC**) |
| *Aspicilia verrucigera* | Hue | R | R | C | BRYC-35526 (**DC**) |
| *Buellia badia* | (Fr.) A. Massal | L | R | C | BRYC-39177 (**TS**) |
| *Buellia disciformis* | (Fr.) Mudd | L | R | C | BRYC-35518 (**DC**), BRYC-37278 (**MJ**) |
| *Caloplaca arenaria* | (Pers.) Müll. Arg. | R | UC | C | BRYC-37566 (**WC**), BRYC-37575a (**WC**), BRYC-39092 (**GP**), BRYC-39094 (**GP**), BRYC-39111 (**TC**), BRYC-39154a (**TS**) |
| *Caloplaca atroalba* | (Tuck.) Zahlbr. | R | R | C | BRYC-35560 (**LF**), BRYC-37256 (**MJ**), BRYC-37267a (**MJ**) |
| *Caloplaca cerina* | (Ehrh. ex Hedwig) Th. Fr. | L, B | R | C | BRYC-35556a (**LF**), BRYC-37285 (**MJ**), BRYC-39088a (**GP**) |
| *Caloplaca ferruginea* | (Hudson) Th. Fr. | B | R | C | BRYC-37283 (**MJ**), BRYC-37556a (**MC**) |
| *Caloplaca fraudans* | (Th. Fr.) H. Olivier | R | UC | C | BYRC-37566 (**WC**), BRYC-37575a (**WC**), BRYC-39092 (**GP**), BRYC-39111 (**TC**), BRYC 39154a-(**TS**) |
| *Caloplaca saxicola* | (Hoffm.) Nordin | R | UC | C | BRYC-37550 (**MC**), BRYC-38252 (**MS**), BRYC-39143 (**TC**), BRYC-39159 (**TS**), BRYC-39700 (**CS**) |
| *Caloplaca subsoluta* | (Nyl.) Zahlbr. | B | R | C | BRYC-35550 (**LF**) |
| *Candelariella antennaria* | Räsänen | B, L | C | C | BRYC-35549 (**LF**), BRYC-35563 (**LF**), BRYC-37595c (**CaC**), BRYC-37562 (**MC**), BRYC-38239 (**MS**), BRYC-39088b (**GP**), BRYC-39108 (**GP**), BRYC-39128 (**TC**), |

| | | | | | |
|---|---|---|---|---|---|
| *(Candelariella antennaria cont.....)* | | | | | BRYC-39138b (**TC**), BRYC-39150 (**TS**), BRYC-39152 (**TS**), BRYC-39169 (**TS**), BRYC-39175 (**TS**), BRYC-39717 (**CS**) |
| *Candelariella citrina* | B. de Lesd. | R | R | C | BRYC-35551 (**LF**) |
| *Candelariella efflorescens* | R. C. Harris & W. R. Buck | L | R | C | BRYC-39133 (**TC**) |
| *Candelariella rosulans* | (Müll. Arg.) Zahlbr. | R | UC | C | BRYC-37571 (**WC**), BRYC-37549a (**MC**), BRYC-37551 (**MC**), BRYC-38194 (**WP**), BRYC-38215 (**BP**) |
| *Candelariella spraguei* | (Tuck.) Zahlbr. | S | R | C | BRYC-35509 (**DC**) |
| *Candelariella vitellina* | (Hoffm.) Müll. Arg. | B, R, S | UC | C | BRYC-37284 (**MJ**), BRYC-37260 (**MJ**), BRYC-37288 (**CC**), BRYC-39082 (**GP**), BRYC-39090b (**GP**), BRYC-39104 (**GP**), BRYC-39113a (**TC**), BRYC-39154b (**TS**), BRYC-39170 (**TS**) |
| *Carbonea vorticosa* | (Flörke) Hertel | R | R | C | BRYC-35539 (**LF**) |
| *Catapyrenium squamellum* | (Nyl. ex Hasse) J. W. Thompson | S | R | S | BRYC-35524 (**DC**) |
| *Circinaria arida* | Owe-Larss., A. Nordin & Tibell | R | R | C | BRYC-35545 (**LF**), BRYC-38196 (**WP**), BRYC-38199 (**WP**), BRYC-39710 (**CS**) |
| *Circinaria calcarea* | (L.) A. Nordin, S. Savić & Tibell | R | R | C | BRYC-39095 (**GP**), BRYC-39168 (**TS**) |
| *Circinaria contorta* | (Hoffm.) A. Nordin, S. Savić & Tibell | R | R | C | BRYC-35528 (**DC**), BRYC-35562 (**LF**), BRYC-37297 (**CC**) |
| *Cladonia cariosa* | (Ach.) Sprengel | S | R | S | Collected by Cheryl Beyer |
| *Collema callopismum* | A. Massal. | R | R | C | BRYC-35564 (**LF**) |
| *Collema crispum* | (Hudson) F. H. Wigg. | R | UC | Fo | BRYC-35510 (**DC**), BRYC-37258 (**MJ**), BRYC-37292 (**CC**), BRYC-37540 (**MC**) |
| *Collema cristatum* | (L.) F. H. Wigg. | R | UC | Fo | BRYC-35533 (**DC**), BRYC-37573b (**WC**), BRYC-37541a (**MC**), BRYC-39122 (**TC**) |
| *Collema fuscovirens* | (With.) J. R. Laundon | R, S | UC | Fo | BRYC-37259 (**MJ**), BRYC-37541b (**MC**), BRYC-38212b (**BP**), BRYC-39080 (**GP**), BRYC-39123 (**TC**), BRYC-39166 (**TS**) |
| *Collema polycarpon* | Hoffm | R, S | UC | Fo | BRYC-35512 (**DC**), BRYC-35536 (**LF**), BRYC-37293 (**CC**), BRYC-37590 (**CaC**), BRYC-38212a (**BP**) |
| *Dermatocarpon lorenzianum* | Anders | R, S | UC | Fo | BRYC-37269 (**MJ**), BRYC-37272 (**MJ**), BRYC-38216 (**BP**), BRYC-38245 (**MS**), BRYC-38248 (**MS**), BRYC-39091b (**GP**), BRYC-39715 (**CS**) |
| *Dermatocarpon luridum* | (With.) J. R. Laundon | R seep areas | R | Fo | Collected by Cheryl Beyer |
| *Dermatocarpon miniatum* | (L.) W. Mann | R, S | A | Fo | BRYC-35494 (**DC**), BRYC-35535 (**LF**), BRYC-37257 (**MJ**), BRYC-37276 (**MJ**), BRYC-37294 (**CC**), BRYC-37569 (**WC**), BRYC-37583a (**CaC**), BRYC-37538 (**MC**), BRYC-38197 (**WP**), BRYC-38211 (**BP**), BRYC-39078 (**GP**), BRYC-39147 (**TC**), BRYC-39157 (**TS**), BRYC-39708 (**CS**), BRYC-39712 (**CS**) |
| *Dermatocarpon vellereum* | Zschacke | R | R | Fo | BRYC-37583b (**CaC**) |

| | | | | | |
|---|---|---|---|---|---|
| *Dimelaena oreina* | (Ach.) Norman | R | R | C | BRYC-38188 (**WP**) |
| *Hyperphyscia adglutinata* | (Flörke) H. Mayrhofer & Poelt | R | R | Fo | BRYC-39132b (**TC**) |
| *Lecania polycycla* | (Anzi) Lettau | R | R | C | BRYC-35511a (**DC**) |
| *Lecanora albellula* | Nyl. | B | R | C | BRYC-37613b (**WC**), BRYC-37595b (**CaC**), BRYC-37599 (**CaC**) |
| *Lecanora crenulata* | Hooker | R | R | C | BRYC-38251 (**MS**), BRYC-39115 (**TC**) |
| *Lecanora densa* | (Śliwa & Wetmore) Printzen | B | R | C | BRYC-49318 (**MS**) |
| *Lecanora dispersa* | (Pers.) Sommerf. | R | R | C | BRYC-35511b (**DC**), BRYC-37300 (**CC**) |
| *Lecanora flowersiana* | H. Magn. | R | R | C | BRYC-37265 (**MJ**) |
| *Lecanora garovaglii* | (Körber) Zahlbr. | R | R | C | BRYC-38198 (**WP**), BRYC-38223 (**BP**), BRYC-38225 (**BP**) |
| *Lecanora hagenii* | (Ach.) Ach. | B | UC | C | BRYC-35556b (**LF**), BRYC-37575c (**WC**), BRYC-37557d (**MC**), BRYC-38260 (**MS**) |
| *Lecanora meridionalis* | H. Magn. | B | R | C | BRYC-37279 (**MJ**) |
| *Lecanora mughicola* | Nyl. | L | R | C | BRYC-38235 (**MS**), BRYC-39176 (**TS**) |
| *Lecanora muralis* | (Schreber) Rabenh. | R | R | C | BRYC-39148 (**TC**) |
| *Lecanora noedegelii* | B. D. Ryan & T. H. Nash | R | R | C | BRYC-37587 (**CaC**) |
| *Lecanora oreinoides* | (Körber) Hertel & Rambold | R | R | C | BRYC-37273 (**MJ**) |
| *Lecanora saligna* | (Schrader) Zahlbr. | L | R | C | BRYC-38241 (**MS**), BRYC-39718 (**TS**) |
| *Lecanora symmicta* | (Ach.) Ach. | B | R | C | BRYC-37613a (**WC**), BRYC-39101 (**GP**) |
| *Lecanora valesiaca* | (Müll. Arg.) Stizenb. | R | R | C | BRYC-35519 (**DC**), BRYC-37552 (**MC**) |
| *Lecanora varia* | (Hoffm.) Ach. | B | UC | C | BRYC-37280 (**MJ**), BRYC-38234 (**BP**), BRYC-39130 (**TC**) |
| *Lecidea laboriosa* | Müll. Arg. | R | R | C | BRYC-38195 (**WP**) |
| *Lecidea leprarioides* | Tønsberg | L | R | C | BRYC-37555 (**MC**), BRYC-39146 (**TC**) |
| *Lecidella carpathica* | Körber | R | UC | C | BRYC-35529 (**DC**), BRYC-35548 (**LF**), BRYC-37255 (**MJ**), BRYC-38219 (**BP**), BRYC-38243 (**MS**) |
| *Lecidella euphorea* | (Flörke) Hertel | B, L | R | C | BRYC-37600a (**CaC**), BRYC-38237 (**MS**), BRYC-49199 (**BL**) |
| *Lecidella stigmatea* | (Ach.) Hertel & Leuckert | R | UC | C | BRYC-35499 (**DC**), BRYC-37267b (**MJ**), BRYC-37298 (**CC**), BRYC-37585 (**CaC**), BRYC-37548 (**MC**) |
| *Lichinella nigritella* | (Lettau) P. P. Moreno & Egea | R | UC | Fo | BRYC-37307 (**CC**), BRYC-37573a (**WC**), BRYC-39079 (**GP**), BRYC-39145 (**TC**) |
| *Lobothallia alphoplaca* | (Wahlenb.) Hafellner | R | R | C | BRYC-38206 (**WP**) |
| *Lobothalia praeradiosa* | (Nyl.) Hafellner | R | R | C | BRYC-39161 (**TS**), BRYC-39713 (**CS**) |

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| *Melanelia tominii* | (Oxner) Essl. | R | R | Fo | BRYC-38204 (**WP**) |
| *Melanohalea elegantula* | (Zahlbr.) O. Blanco et al. | B, R | UC | Fo | BRYC-35521b (**DC**), BRYC-37579b (**CaC**), BRYC-38193 (**WP**), BRYC-38202 (**WP**), BRYC-38231 (**BP**), BRYC-39131 (**TC**), BRYC-39134 (**TC**) |
| *Melanohalea exasperatula* | (Nyl.) O. Blanco et al. | B | UC | Fo | BRYC-35558 (**LF**), BRYC-38209 (**WP**), BRYC-38210 (**WP**), BRYC-38262 (**MS**), BRYC-39140 (**TC**), BRYC-49198 (**BL**) |
| *Melanohalea subelegantula* | (Essl.) O. Blanco et al. | B | R | Fo | BRYC-37579b (**CaC**), BRYC-38227b (**BP**) |
| *Melanohalea subolivacea* | (Nyl.) O. Blanco et al. | B | A | Fo | BRYC-35515a (**DC**), BRYC-35521a (**DC**), BRYC-35553 (**LF**), BRYC-37282 (**MJ**), BRYC-37310 (**CC**), BRYC-37313 (**CC**), BRYC-37608 (**WC**), BRYC-37609 (**WC**), BRYC-37579a (**CaC**), BRYC-37596 (**CaC**), BRYC-37602 (**CaC**), BRYC-37558a (**MC**), BRYC-49194 (**MC**), BRYC-38226 (**BP**), BRYC-38227a (**BP**), BRYC-38230 (**BP**), BRYC-49319 (**MS**), BRYC-39100 (**GP**), BRYC-39106 (**GP**), BRYC-39135 (**TC**), BRYC-39139 (**TC**), BRYC-49204 (**BL**) |
| *Parmeliopsis ambigua* | (Wulfen) Nyl. | L | R | Fo | BRYC-35540 (**LF**) |
| *Peltigera rufescens* | (Weiss) Humb. | M, B | R | Fo | BRYC-35504 (**DC**), BRYC-37312 (**CC**) |
| *Phaeophyscia kairamoi* | (Vainio) Moberg | S | R | Fo | BRYC-37588 (**CaC**) |
| *Phaeophyscia nigricans* | (Flörke) Moberg | M, B | R | Fo | BRYC-37589 (**CaC**), BRYC-39151 (**TS**), BRYC-39706 (**CS**) |
| *Phaeophyscia sciastra* | (Ach.) Moberg | R | R | Fo | BRYC-35507 (**DC**), BRYC-37545 (**MC**) |
| *Physcia adscendens* | (Fr.) H. Olivier | B, L | R | Fo | BRYC-38255 (**MS**), BRYC-39109 (**GP**), BRYC-39132a (**TC**) |
| *Physcia biziana* | (A. Massal.) Zahlbr. | B, R | R | Fo | BRYC-37558b (**MC**), BRYC-37559a (**MC**), BRYC-37561b (**MC**), BRYC-38205b (**WP**), BRYC-38256c (**MS**) |
| *Physcia caesia* | (Hoffm.) Fürnr | R | UC | Fo | BRYC-35497 (**DC**), BRYC-37306 (**CC**), BRYC-37547 (**MC**), BRYC-37544 (**MC**), BRYC-38205a (**WP**) |
| *Physcia dimidiata* | (Arnold) Nyl. | B | R | Fo | BRYC-38229 (**BP**) |
| *Physcia dubia* | (Hoffm.) Lettau | B, L,R | C | Fo | BRYC-35506 (**DC**), BRYC-38118 (**WC**), BRYC-37561a (**MC**), BRYC-38189 (**WP**), BRYC-38221 (**BP**), BRYC-38238 (**MS**), BRYC-38257 (**MS**), BRYC-39129 (**TC**), BRYC-39701 (**CS**) |
| *Physcia stellaris* | (L.) Nyl. | B, L | A | Fo | BRYC-35516a (**DC**), BRYC-35520 (**DC**), BRYC-35554 (**LF**), BRYC-37281 (**MJ**), BRYC-37277 (**MJ**), BRYC-37315 (**CC**), BRYC-37309 (**CC**), BRY C-37606 (**WC**), BRY C-37612 (**WC**), BRYC-37604 (**CaC**), BRYC-37578 (**CaC**), BRYC-37598a (**CaC**), BRYC-37554 (**MC**), BRYC-37557 (**MC**), BRYC-49197 (**MC**), BRYC-38228 (**BP**), BRYC-38256a (**MS**), BRYC-38253 (**MS**), BRYC-49316 (**MS**), BRYC-39105 (**GP**), BRYC-39110 (**GP**), BRYC-39136 (**TC**), BRYC-39178 (**TS**), BRYC-49203 (**BL**) |
| *Physcia tenella* | (Scop.) DC. | B | R | Fo | BRYC-38256b (**MS**) |
| *Physciella chloantha* | (Ach.) Essl. | B, L, R | C | Fo | BRYC-35508 (**DC**), BRYC-35559 (**LF**), BRYC-37595b (**CaC**), BRYC-37580 (**CaC**), BRYC-37601 (**CaC**), BRYC-37557c (**MC**), |

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| *(Physciella chloantha cont...)* | | | | | BRYC-37563a (**MC**), BRYC-39085 (**GP**), BRYC-39171 (**TS**), BRYC-39173 (**TS**), BRYC-39174b (**TS**), BRYC-39716 (**CS**), BRYC-49201 (**BL**) |
| *Physconia elegantula* | Essl. | S | R | Fo | BRYC-37543 (**MC**) |
| *Physconia isidiigera* | (Zahlbr.) Essl. | M | R | Fo | BRYC-35502 (**DC**) |
| *Placidium squamulosum* | (Ach.) Breuss | S | UC | S | BRYC-35565 (**LF**), BRYC-37568 (**WC**), BRYC-37582 (**CaC**), BRYC-37539 (**MC**), BRYC-39142 (**TC**), BRYC-39163 (**TS**), BRYC-39707 (**CS**), BRYC-39711 (**CS**) |
| *Placopyrenium stanfordii* | (Herre) K. Knudsen | R | R | C | BRYC-39093 (**GP**) |
| *Pleopsidium flavum* | (Bellardi) Körber | R | R | C | BRYC-38201 (**WP**) |
| *Polysporina urceolata* | (Anzi) Brodo | R | R | C | BRYC-35523 (**DC**) |
| *Psora cerebriformis* | W. A. Weber | S | R | S | BRYC-39124 (**TC**) |
| *Psora himalayana* | (Church. Bab.) Timdal | S | R | S | BRYC-37289 (**CC**), BRYC-37291 (**CC**), BRYC-37536 (**MC**), BRYC-39141 (**TC**) |
| *Psora tuckermanii* | R. A. Anderson ex Timdal | S, R | A | S | BRYC-35501 (**DC**), BRYC-35527 (**DC**), BRYC-35541 (**LF**), BRYC-35546 (**LF**), BRYC-37271 (**MJ**), BRYC-37275 (**MJ**), BRYC-37287 (**CC**), BRYC-37290 (**CC**), BRYC-37570 (**WC**), BRYC-37584 (**CaC**), BRYC-37535 (**MC**), BRYC-38214 (**BP**), BRYC-38246 (**MS**), BRYC-39102 (**GP**), BRYC-39089 (**GP**), BRYC-39081 (**GP**), BRYC-39125 (**TC**), BRYC-39158 (**TS**) |
| *Rhizoplaca chrysoleuca* | (Sm.) Zopf | R | R | Fo | BRYC-38200 (**WP**) |
| *Rhizoplaca melanophthalma* | (DC.) Leuckert & Poelt | R | UC | Fo | BRYC-38192 (**WP**), BRYC-38222 (**BP**), BRYC-39116 (**TC**), BRYC-39155 (**TS**), BRYC-39702 (**CS**) |
| *Rhizoplaca peltata* | (Ramond) Leuckert & Poelt | R | R | Fo | BRYC-38203 (**WP**) |
| *Rinodina capensis* | Hampe | L | R | C | BRYC-38236 (**MS**) |
| *Rinodina conradii* | Körber | R | R | C | BRYC-37593 (**CaC**) |
| *Rinodina endospora* | Sheard | L | R | C | BRYC-38240 (**MS**) |
| *Rinodina lobulata* | H. Mayrhofer & Sheard | B | UC | C | BRYC-35517 (**DC**), BRYC-37607a (**WC**), BRYC-37600b (**CaC**), BRY C-49202 (**BL**) |
| *Rinodina pyrina* | (Ach.) Arnold | B | R | C | BRYC-37605b (**WC**), BRYC-37611 (**WC**), BRYC-37557b (**MC**) |
| *Sarcogyne clavus* | (DC.) Kremp. | R | R | C | BRYC-37303 (**CC**) |
| *Sarcogyne regularis* | Körber | R | R | C | BRYC-35537 (**LF**), BRYC-39098 (**GP**) |
| *Sarcogyne similis* | H. Magn. | R | R | C | BRYC-35547 (**LF**) |
| *Seirophora contortuplicata* | (Ach.) Fröden | R | R | Fo | BRYC-37302 (**CC**) |
| *Solorina spongiosa* | (Ach.) Anzi | M | R | S | Collected by Cheryl Beyer |
| *Staurothele areolata* | (Ach.) Lettau | R | A | C | BRYC-35498 (**DC**), BRYC-37262 (**MJ**), BRYC-37263 (**MJ**), BRYC-37266 (**MJ**), BRYC-37268 |

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| *(Staurothele Areolata cont…)* | | | | | (**MJ**), BRY C-37270 (**MJ**), BRYC-37296 (**CC**), BRYC-37564 (**WC**), BRYC-37594 (**CaC**), BRYC -37537 (**MC**), BRYC-37550 (**MC**), BRYC-38220 (**BP**), BRYC-38244 (**MS**), BRYC-39144 (**TC**) |
| *Staurothele drummondii* | (Tuck.) Tuck. | R | UC | C | BRYC-35532 (**DC**), BRYC-35542 (**LF**), BRYC-35543 (**LF**), BRYC-37575b (**WC**), BRYC-38242 (**MS**), BRYC-39086a (**GP**), BRYC-39097 (**GP**), BRYC-39099 (**GP**), BRYC-39114 (**TC**) |
| *Staurothele polygonia* | B. de Lesd. | R | R | C | BRYC-39087a (**GP**) |
| *Strangospora microhaema* | (Norman) R. A. Anderson | B | R | C | BRYC-37607b (**WC**), BRYC-37577b (**CaC**), BRYC-37595a (**CaC**), BRYC-37597b (**CaC**), BRYC-37598c (**CaC**), BRYC-37556b (**MC**) |
| *Tonina candida* | (Weber) Th. Fr. | S, R | R | S | BRYC-37295 (**CC**), BRYC-37591 (**CaC**), BRYC-38217 (**BP**) |
| *Toninia sedifolia* | (Scop.) Timdal | S | R | S | BRYC-37572 (**WC**), BRYC-37546 (**MC**), BRYC-39164 (**TS**) |
| *Umbilicaria hyperborea* | (Ach.) Hoffm. | R | R | Fo | BRYC-39703 (**CS**) |
| *Usnea hirta* | (L.) F. H. Wigg. | B | R | Fr | BRYC-49317 (**MS**) |
| *Usnea lapponica* | (Vainio) | B | R | Fr | BRYC-49195 (**MC**) |
| *Xanthomendoza fallax* | (Hepp ex Arnold) Søchting, Kärnefelt & S. Kondr. | B | C | Fo | BRYC-39149 (**DC**), BRYC-37577a (**CaC**), BRYC-37563b (**MC**), BRYC-38208 (**WP**), BRYC-38233 (**BP**), BRYC-38259 (**MS**), BRYC39120 (**TC**), BRYC-39121 (**TC**) |
| *Xanthomendoza montana* | (L. Lindblom) Søchting, Kärnefelt & S. Kondr | B, L | A | Fo | BRYC-35514 (**DC**), BRYC-35515b (**DC**), BRYC-35516b (**DC**), BRYC-35522 (**DC**), BRYC-35552 (**LF**), BRYC-37286 (**MJ**), BRYC-37311 (**CC**), BRYC-37314 (**CC**), BRYC-37605a (**WC**), BRYC-37610 (**WC**), BRYC-38117 (**WC**), BRYC-37576 (**CaC**), BRYC-37597a (**CaC**), BRYC-37603 (**CaC**), BRYC-37557e (**MC**), BRYC-37559b (**MC**), BRYC-38232 (**BP**), BRYC-38254 (**MS**), BRYC-38258 (**MS**), BRYC-49320 (**MS**), BRYC-39088c (**GP**), BRYC-39107 (**GP**), BRYC-39119 (**TC**), BRYC-39126 (**TC**), BRYC-39127 (**TC**), BRYC-39174a (**TS**), BRYC-49200 (**BL**) |
| *Xanthoparmelia cumberlandia* | (Gyelnik) Hale | R | R | Fo | BRYC-38207 (**WP**) |
| *Xanthoparmelia mexicana* | (Gyelnik) Hale | R | R | Fo | BRYC-38191 (**WP**), BRYC-39705 (**CS**) |
| *Xanthoria elegans* | (Link) Th. Fr. | R | A | Fo | BRYC-35495 (**DC**), BRYC-35561 (**LF**), BRYC-37254 (**MJ**), BRYC-37308 (**CC**), BRYC-37565 (**WC**), BRYC-37581 (**CaC**), BRYC-37542 (**MC**), BRYC-38190 (**WP**), BRYC-38213 (**BP**), BRYC-39083 (**GP**), BRYC-39117 (**TC**), BRYC-39162 (**TS**), BRYC-39709 (**CS**) |
| *Xanthoria sorediata* | (Vainio) Poelt | R | R | Fo | BRYC-35496 (**DC**) |
| *Xylographa parallela* | (Ach. : Fr.) Behlen & Desberger | L | R | C | BRYC-35557 (**LF**) |

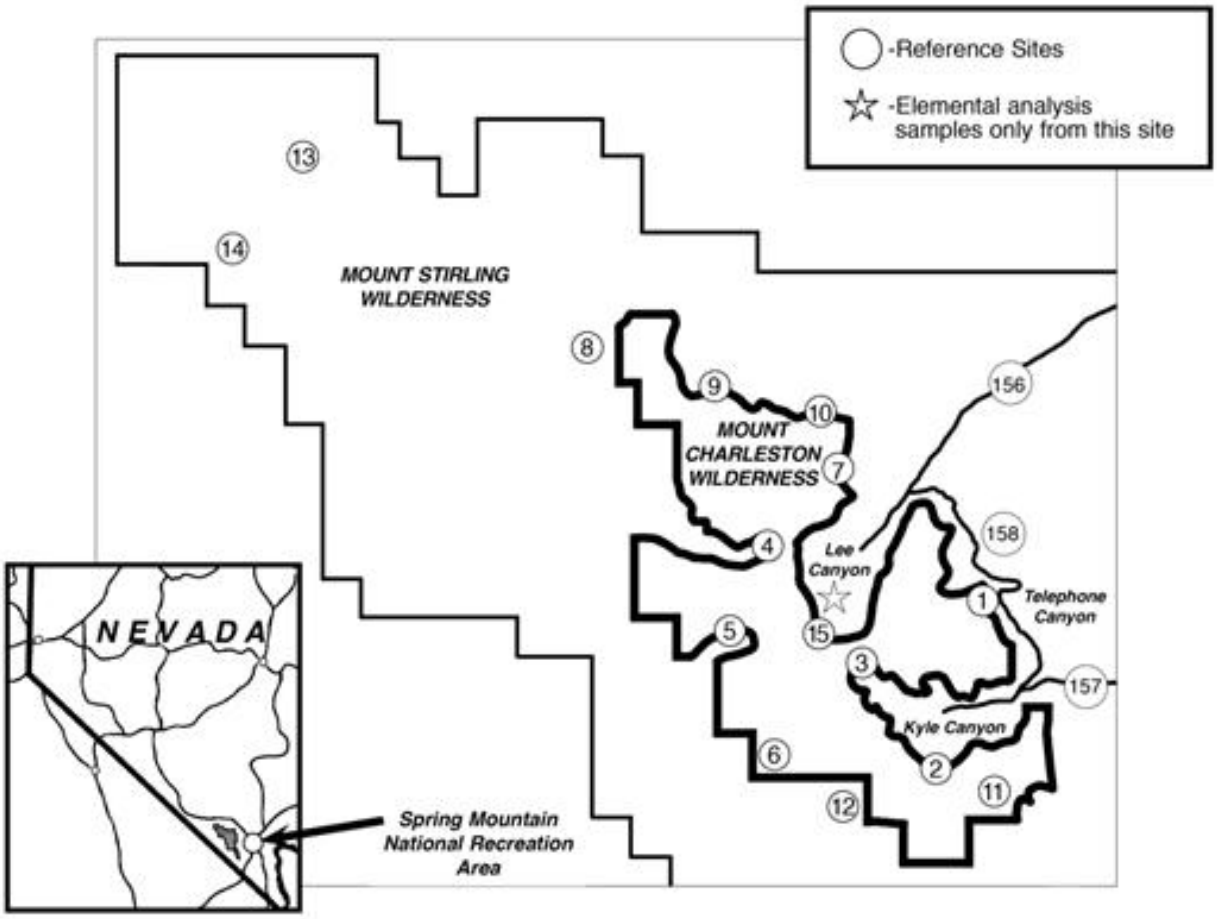


**Figure 1.** Spring Mountains air quality bio-monitoring collection sites with inset showing the general location of the National Recreation Area within the state of Nevada (St. Clair, 2007).

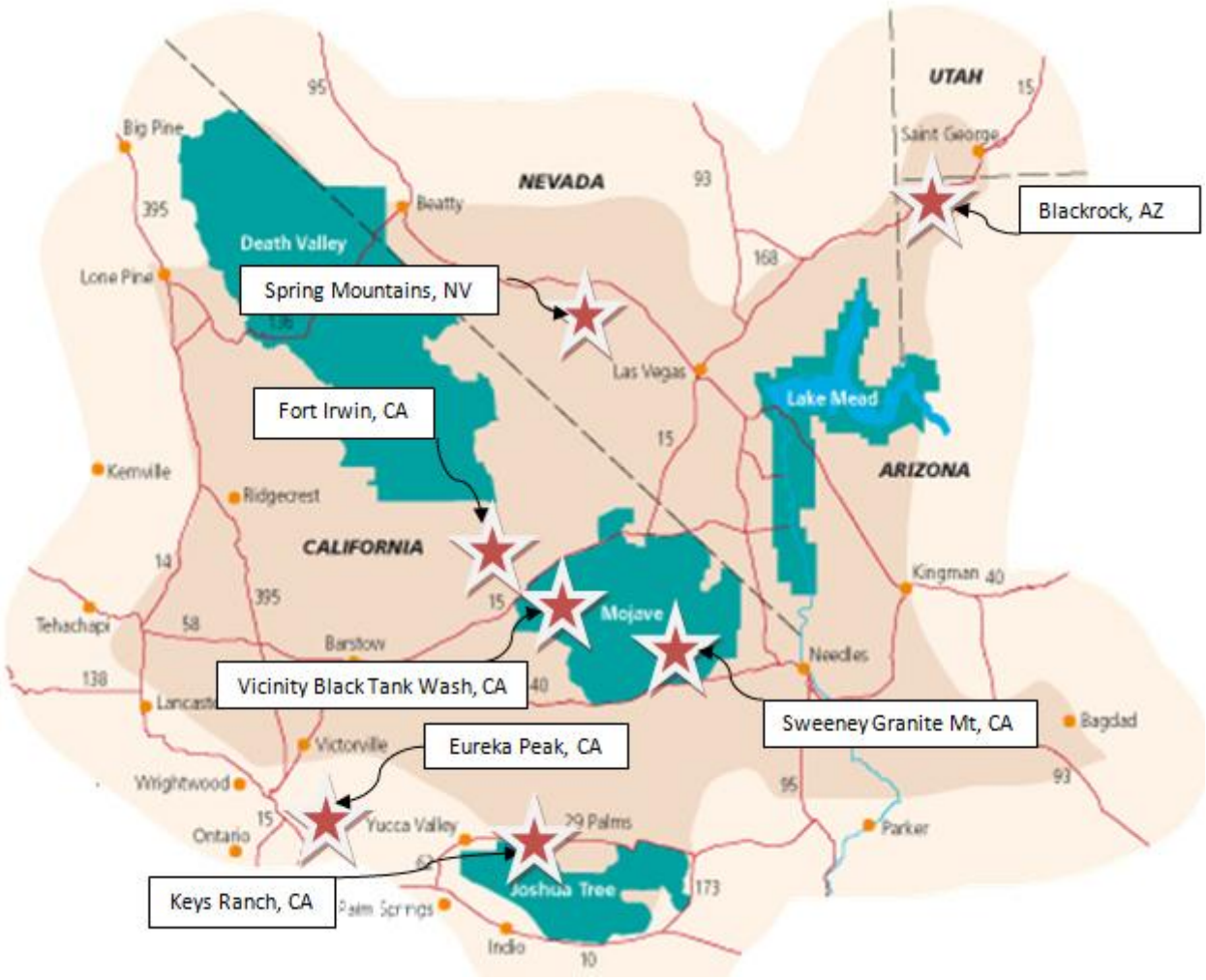


**Figure 2.** Lichen collection sites in the Mojave Desert (Digital Desert).