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FINAL REPORT SUBMITTED TO

**DINOSAUR NATIONAL MONUMENT
NATIONAL PARK SERVICE**

REGARDING:

**ESTABLISHMENT OF A LICHEN BIOMONITORING PROGRAM AND AIR
QUALITY BASELINE FOR DINOSAUR NATIONAL MONUMENT**

COPY

SUBMITTED BY

**LARRY ST. CLAIR, Ph.D.
PROFESSOR OF BOTANY AND CURATOR OF
NON-VASCULAR CRYPTOGRAMS
BRIGHAM YOUNG UNIVERSITY
PROVO, UTAH 84602**

**SAMUEL B. ST. CLAIR, RESEARCH ASSOCIATE
DEPARTMENT OF PLANT PHYSIOLOGY
THE PENNSYLVANIA STATE UNIVERSITY
STATE COLLEGE, PENNSYLVANIA 16803**

**AND
CLAYTON C. NEWBERRY, RESEARCH ASSOCIATE
DEPARTMENT OF INTEGRATIVE BIOLOGY
UNIVERSITY OF CALIFORNIA, BERKELEY, CALIFORNIA 94720**

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EXECUTIVE SUMMARY

Between 1991 and 1999 a total of 18 lichen air quality biomonitoring reference sites were established in Dinosaur National Monument. To date 168 species in 55 genera have been identified from our collections. Typical of Intermountain Area lichen floras most of the species from the monument are of the crustose growth form (51% or 85 species). During the course of this study specimens were collected from five different substrates (rocks, bark/lignum, soil, other lichens, and moss/detritus), with most species occurring on rock substrates (50% or 85 species).

A total of 32 elemental analysis samples were collected from the 18 air quality biomonitoring reference sites in the monument. At least one sensitive indicator species from each reference site was analyzed for 21 potential pollutant elements. Included in this collection are a total of 8 sensitive indicator species collected from two basic substrates (rock and bark). An average of 7.2 sensitive indicator species were identified from each reference site (range: 3-19). This compares with an average of 6.3 along the Wasatch Front; 8.0 in the Bridger Wilderness Area (western Wyoming); and 10.3 in the High Uintas Wilderness Area (northeastern Utah). Elemental analysis data suggest some areas of concern. Sulfur concentrations in lichen tissues from 4/26 samples were elevated (.20-.24%). Furthermore, thallus concentrations of arsenic (1.4-7.9 ppm) and chromium (2.9-27 ppm) were elevated in all elemental analysis samples. The only samples with similar values for these elements are from reference sites along the heavily impacted Wasatch Front. Overall, high species diversity, the absence of bleached and/or necrotic thalli, and the moderate number of sensitive indicator species per site (7.2) suggests that the lichen flora of Dinosaur National Monument is generally healthy and unimpacted by air pollution. However, concentrations of As, Cr, and S in sensitive indicator species should be carefully monitored. Generally, reevaluation of pollutant levels in tissues of sensitive indicator species should be conducted every 4-5 years.

INTRODUCTION

PROJECT OBJECTIVES:

1. Establish 18 reference sites within the monument.
2. Collect, curate, and identify lichen species from various habitats and substrates at each reference site.
3. Identify 3-5 pollution-sensitive lichen species at each reference site. Collect enough tissue of one sensitive species (approximately 6-10 grams dry weight) from each reference site for elemental analyses. Rare species will not be sampled for analysis, but their distribution will be noted.
4. Determine baseline thallus concentrations of 20 potential pollutant elements (including sulfur, selenium, arsenic, copper, nickel, chromium, bromine, titanium, manganese, lead, vanadium, potassium, iron, zinc, etc.), using replicate samples of one documented pollution-sensitive species collected from each reference site. Samples will be analyzed using PIXE analysis techniques.
5. Prepare and submit a draft report.

6. Prepare and submit a final report detailing the results of this study by 30 September 2000

LICHENS AS BIOLOGICAL INDICATORS OF AIR QUALITY:

Lichens have been used extensively as bioindicators of air quality (Fields & St. Clair 1984; St. Clair 1989; Richardson 1992). Hale (1983) noted that lichens have been used in three basic ways to monitor the effects of air pollution on biological communities: 1) elemental analysis of lichen tissues, 2) mapping of all (or selected) lichen species found in areas adjacent to pollution sources, and 3) transplant studies. Currently, the most common approach includes a floristic survey along with analysis of sensitive indicator species samples for potential pollutant elements (St. Clair and Newberry 1995; Wetmore 1989).

As lichens accumulate a variety of pollutants from atmospheric outwash, lichen tissues provide a record of the kinds and relative quantities of air pollutants in any particular airshed (Schutte 1977; Wetmore 1989; Rope & Pearson 1990). Pollutant accumulation patterns for specific elements have been monitored over time by correlating thallus growth rates with pollutant concentrations in precisely excised portions of lichen thalli (Lawrey & Hale 1981). Changes in lichen physiological processes indicate pollution-related damage long before other, more easily discernible characteristics such as changes in thallus color, morphology, or community structure become apparent (Fields & St. Clair 1984).

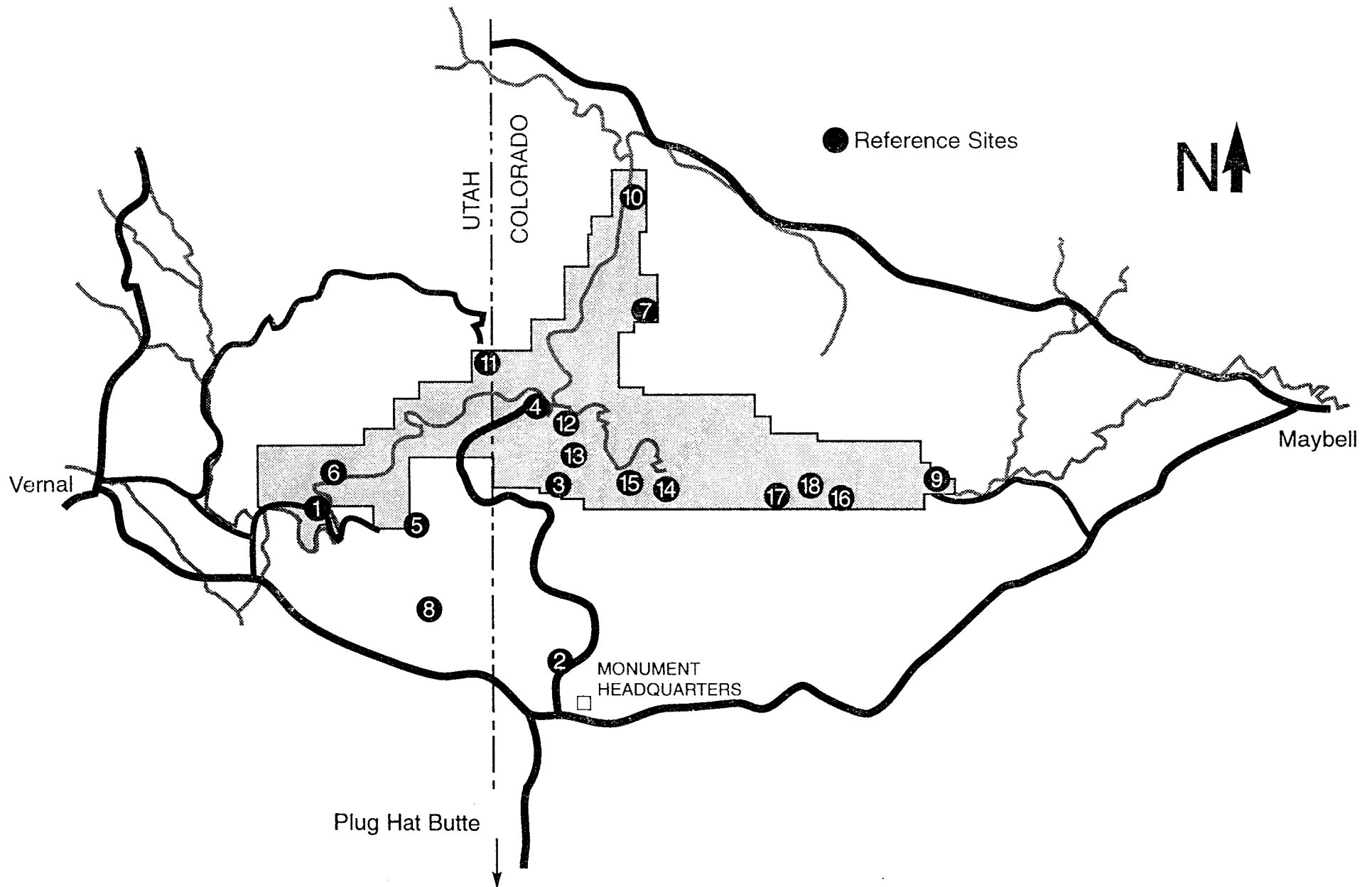
Lists of pollution-sensitive lichen species are frequently published in conjunction with floristic and ecological surveys (Rushforth et al. 1982; Wetmore 1989). As certain lichen species are inherently more sensitive to airborne contaminants, air quality can be effectively monitored by occasionally reevaluating lichen community and/or physiological parameters. Pollution-related changes can then be documented by comparing follow up data with original baseline data.

GENERAL HABITAT DESCRIPTION FOR DINOSAUR NATIONAL MONUMENT:

Dinosaur National Monument straddles the border between Utah and Colorado along the northern edge of the Colorado Plateau and the southeastern flank of the Uinta Mountains. The monument contains a variety of plant communities, ranging from upper elevation sites dominated by Douglas Fir, Quaking Aspen, Ponderosa Pine, and Serviceberry to middle elevation sites with Mountain Mahogany, Ponderosa Pine, Pinyon Pine, Utah Juniper, Ephedra, and Big Sagebrush to arid lowlands dominated by various desert shrub species including Sagebrush, Greasewood, and Shadscale. The riparian community along the Green and Yampa rivers includes Cottonwoods, Boxelder Maple, Willows, River Birch, and Snowberry.

The geology of the Monument is variable and complex. The oldest exposed rocks are in the Canyon of Lodore, where the Green River has eroded the riverbed down to partly metamorphosed Precambrian sedimentary rocks including, quartzite, marble, and slaty shale from the Uinta Mountain group. Paleozoic sedimentary rocks, mostly of marine origin, overlay the Precambrian strata, with the cross-bedded Weber sandstone forming the steep cliffs along the Yampa and Green rivers. Later during the Jurassic the sandstones and mudstones of the Morrison formation were deposited when the area was covered with a swampy, shallow inland sea. During the course of this study a total of 18 air quality biomonitoring reference sites were established in the monument (Figure 1).

Dinosaur National Monument



LICHEN BIOMONITORING REFERENCE SITES IN DINOSAUR NATIONAL MONUMENT:

Over the last eight years 18 air quality biomonitoring reference sites have been established in Dinosaur National Monument. Specifically, reference sites have been established at the following locations:

Site No.1: 30 August 1991 and 4 August 1999. Utah, Uintah County, Dinosaur National Monument, along Red Rock Nature Trail (Desert Voices Nature Trail) at 40° 26.629' north latitude; 109° 15.822' west longitude. Elevation: 1585 m (5200 feet).

Site No. 2: 31 August 1991. Colorado, Moffat County, Dinosaur National Monument, Plug Hat Picnic Area at 40° 17.584' north latitude; 108° 57.991' west longitude. Elevation: 2073 m (6800 feet).

Site No. 3: 31 August 1991. Colorado, Moffat County, Dinosaur National Monument, Canyon Overlook at 40° 27.284' north latitude; 109° 00.911' west longitude. Elevation: 2377 m (7800 feet).

Site No. 4: 31 August 1991. Colorado, Moffat County, Dinosaur National Monument, Harper's Corner at 40° 31.487' north latitude; 109° 01.109' west longitude. Elevation: 2438 m (8000 feet).

Site No. 5: 27 September 1991. Utah, Uintah County, Dinosaur National Monument, Hog Canyon at 40° 25.743' north latitude; 109° 10.088' west longitude. Elevation 1646 m (5400 feet).

Site No. 6: 28 September 1991. Utah, Uintah County, Dinosaur National Monument, canyon east of Split Mountain Gorge (across Green River from Split Mountain Gorge Campground) at 40° 26.723' north latitude; 109° 14.781' west longitude. Elevation: 1585 m (5200 feet).

Site No. 7: 26 September 1991. Colorado, Moffat County, Dinosaur National Monument, vicinity of Zenobia Peak at 40° 36.419' north latitude; 108° 52.105' west longitude. Elevation: 2745 m (9006 feet).

Site No. 8: 27 September 1991. Utah, Uintah County, south of Dinosaur National Monument, Cliff Ridge, Point of Pines at 40° 21.330' north latitude; 109° 9.222' west longitude. Elevation: 2286 m (7500 feet).

Site No. 9: 5 June 1992. Colorado, Moffat County, Dinosaur National Monument, vicinity of Deer Lodge Park at 40° 26.791' north latitude; 108° 31.009' west longitude. Elevation: 1707 m (5600 feet).

- Site No. 10:** 6 June 1992. Colorado, Moffat County, Dinosaur National Monument, Gates of Lodore at 40° 42.736' north latitude; 108° 53.904' west longitude. Elevation: 1676 m (5500 feet).
- Site No. 11:** 14 June 1994. Utah, Uintah County, Dinosaur National Monument, along Jones Hole Creek at 40° 34.825' north latitude; 109° 03.109' west longitude. Elevation: 1798 m (5900 feet).
- Site No. 12:** 15 June 1994. Colorado, Moffat County, Dinosaur National Monument, Echo Park (rocky slope east of campground) at 40° 31.178' north latitude; 108° 58.829' west longitude. Elevation: 1646 m (5400 feet).
- Site No. 13:** 15 June 1994. Colorado, Moffat County, Dinosaur National Monument, mouth of Sand Canyon at 40° 29.206' north latitude; 108° 59.598' west longitude. Elevation: 1676 m (5500 feet).
- Site No. 14:** 16 June 1994. Colorado, Moffat County, Dinosaur National Monument, vicinity of Harding Hole Overlook at 40° 27.826' north latitude; 108° 51.688' west longitude. Elevation: 1768 m (5800 feet).
- Site No. 15:** 16 June 1994. Colorado, Moffat County, Dinosaur National Monument, along Mantle Ranch Road (Yampa Bench Road), 2 km west-northwest of Mantle Ranch turnoff at 40° 28.018' north latitude; 108° 54.268' west longitude. Elevation 1675 m (5500 feet).
- Site No. 16:** 3 August 1999. Colorado, Moffat County, Dinosaur National Monument, pass south of Thanksgiving Point, along Mantle Ranch Road (Yampa Bench Road) at 40° 26.457' north latitude; 108° 38.550' west longitude. Elevation (from map): 2073 m (6800 feet).
- Site No. 17:** 5 August 1999. Colorado, Moffat County, Dinosaur National Monument, along Mantle Ranch Road (Yampa Bench Road), 8 km west of turnoff to Haystack Rock at 40° 27.347' north latitude; 108° 45.374' west longitude. Elevation: 2042 m (6700 feet).
- Site No. 18:** 5 August 1999. Colorado, Moffat County, Dinosaur National Monument, vicinity of Haystack Rock, north of Mantle Ranch Road (Yampa Bench Road) at 40° 27.563' north latitude; 108° 40.070' west longitude. Elevation: 1951 m (6400 feet).

METHODS

COLLECTION, CURATION, IDENTIFICATION, AND DEPOSITION OF LICHEN SPECIES:

Because lichen distribution is influenced by substrate, moisture availability, and sunlight all appropriate substrates and habitats at each reference site were carefully examined. Small amounts of each lichen species were either removed directly from the substrate, or depending on the species, with a small piece of the substrate (bark, wood, soil, or rock).

All specimens were placed in carefully labeled paper sacks and taken back to the BYU Herbarium of Nonvascular Cryptogams, where they were curated, identified, placed in permanent herbarium packets, and labeled with the current epithets and authors' names as well as detailed information about the collection site, habitat, and substrate. Herbarium numbers (BRY C-) have been assigned to each specimen.

Species were identified using standard lichen keys and taxonomic treatises. Chemical spot tests and, where necessary, thin-layer chromatography techniques were used to finalize species identifications.

The specimens will be on loan to the BYU Herbarium of Nonvascular Cryptogams in Provo, Utah. Numbering, labeling and accountability for specimens will follow Park Service protocol. Collection data will be entered into ANCS.

COLLECTION OF LICHEN THALLI FOR LABORATORY ANALYSES:

After careful consideration of species, substrates, growth forms, documented/suspected pollution sensitivities, and general distribution patterns one to several pollution sensitive indicator species were collected and returned to BYU where elemental analyses were performed using PIXE technology.

At each reference site sufficient material of at least one sensitive indicator species was collected for elemental analyses (3-6 grams dry weight). Elemental analysis samples were placed in Nasco sterile plastic bags (to avoid contamination) and transported back to the BYU Herbarium of Nonvascular Cryptogams. Excess elemental analysis material is permanently stored in Nasco sterile plastic bags in the elemental analysis collection at the BYU Herbarium of Nonvascular Cryptogams. This material is available for additional testing upon request.

DETERMINATION OF ELEMENTAL CONCENTRATIONS IN LICHEN TISSUES:

In the laboratory, surface debris and dust were removed from all elemental analysis samples. Clean, two gram samples of at least one sensitive indicator species from each reference site were delivered to the Elemental Analysis Laboratory at Brigham Young University.

Samples were prepared for PIXE analysis using the methods of Duflou et al. (1987). Lichen samples were placed in Teflon containers with a teflon coated steel ball, cooled to liquid nitrogen temperature, powdered by brittle fracture using a Braun Mikro-Dismemberator II, and then dried in an Imperial IV Microprocessor Oven for 14 hours at 80°C. Subsamples weighing 150 mg were then weighed in to teflon containers and spiked with 1 ml of a 360 ppm yttrium solution. The samples were then oven dried again for 14 hours at 80°C. Samples were then homogenized again using the micro-dismemberator. Approximately 1 mg of the powdered lichen was then carefully weighed onto a thin

polycarbonate film in an area of 0.5 cm². A 1.5% solution of polystyrene in toluene was used to secure the sample to the film.

Samples were analyzed using a 2 MV Van de Graaff accelerator with a 2.28 MeV proton beam which passed through a 1.1 mg/cm² pyrolytic graphite diffuser foil. The proton beam was collimated to irradiate an area of 0.38 cm² on the sample. Typically, 10-100 nA proton beam currents were used. X-rays were detected using a Tracor X-ray Spectrometer, model TX-3/48-206, with a 10 mm² by 3 mm thick Si(Li) detector positioned at 90° to the proton beam. Samples were analyzed twice using different X-ray absorbers between the samples and the detector. One was a 49 mg/cm² mylar absorber with a 0.27 mm² pinhole (2.8% of detector area). The mylar was backed with an 8.5 mg/cm² beryllium foil. A 98 mg/cm² mylar absorber was also used.

To insure adequate quality control, samples of NIST SRM 1571 orchard leaves, and other standards were prepared and analyzed using the same procedures.

RESULTS, OBSERVATIONS, CONCLUSIONS, AND RECOMMENDATIONS

LICHEN MATERIAL COLLECTED FOR ELEMENTAL ANALYSES:

A total 32 samples including 8 species from 2 substrates (rock and bark) were collected for elemental analyses. Analysis of at least one specimen from each reference site was performed using Proton Induced X-ray Emission (PIXE) technology. Below is a list of the elemental analysis samples by sample number, species, substrate, and collection site (the first number under "sample number" represents the storage drawer while the second number indicates the bag number). All specimens are stored in Nasco sterile plastic bags in the elemental analysis collection in the Herbarium of Nonvascular Cryptogams at Brigham Young University.

| Sample # | Taxa | Substrate | Reference Site |
|----------|-----------------------------|-----------|----------------|
| 3-24 | Rhizoplaca peltata | rock | 1 |
| 3-25 | Rhizoplaca peltata | rock | 6 |
| 3-26 | Dematocarpon miniatum | rock | 5 |
| 4-27 | Rhizoplaca peltata | rock | 2 |
| 4-28 | Glypholecia scabra | rock | 2 |
| 18-143 | Rhizoplaca peltata | rock | 8 |
| 18-144 | Dermatocarpon miniatum | rock | 9 |
| 18-145 | Rhizoplaca peltata | rock | 9 |
| 23-183 | Rhizoplaca peltata | rock | 10 |
| 23-184 | Dermatocarpon miniatum | rock | 10 |
| 34-302 | Rhizoplaca melanophthalma | rock | 14 |
| 34-303 | Rhizoplaca peltata | rock | 13 |
| 34-304 | Rhizoplaca melanophthalma | rock | 15 |
| 34-305 | Xanthoparmelia plittii | rock | 15 |
| 34-306 | Rhizoplaca peltata | rock | 11 |
| 34-307 | Rhizoplaca melanophthalma | rock | 11 |
| 35-308 | Xanthoparmelia cumberlandia | rock | 12 |

| Sample # | Taxa | Substrate | Reference Site |
|-----------------|---------------------------|------------------|-----------------------|
| 35-309 | Rhizoplaca melanophthalma | rock | 12 |
| 35-310 | Lecanora muralis | rock | 12 |
| 52-764 | Rhizoplaca peltata | rock | 1 |
| 52-765 | Xanthoria polycarpa | bark | 1 |
| 52-766 | Xanthoria polycarpa | bark | 3 |
| 52-767 | Rhizoplaca melanophthalma | rock | 3 |
| 52-768 | Rhizoplaca melanophthalma | rock | 4 |
| 52-769 | Xanthoria polycarpa | bark | 4 |
| 52-770 | Rhizoplaca melanophthalma | rock | 1 |
| 52-771 | Xanthoria polycarpa | bark | 1 |
| 52-772 | Xanthoria polycarpa | bark | 17 |
| 52-773 | Rhizoplaca melanophthalma | rock | 17 |
| 52-774 | Xanthoria polycarpa | bark | 16 |
| 52-775 | Rhizoplaca peltata | rock | 16 |
| 52-776 | Xanthoria polycarpa | bark | 18 |

LIST OF POLLUTION SENSITIVE INDICATOR SPECIES BY REFERENCE SITE:

Red Rock Nature (Desert Voices) Trail (Site No. 1):

Physcia dubia (sensitive to intermediately sensitive to fluoride)
Rhizoplaca chrysoleuca (sensitive to sulfur dioxide and NO_x/PAN)
Rhizoplaca melanophthalma (sensitive to sulfur dioxide and NO_x/PAN)
Xanthoria elegans (intermediately sensitive to sulfur dioxide)
Xanthoria fallax (sensitive to intermediately sensitive to sulfur dioxide)
Xanthoria polycarpa (sensitive to intermediately sensitive to sulfur dioxide)

Plug Hat Picnic Area (Site No. 2):

Caloplaca cerina (sensitive to intermediately sensitive to sulfur dioxide)
Melanelia exasperatula (intermediately sensitive to sulfur dioxide)
Melanelia subolivacea (intermediately sensitive to ozone)
Physcia dubia (sensitive to intermediately sensitive to fluoride)
Physcia stellaris (intermediately sensitive to sulfur dioxide)
Usnea hirta (sensitive to intermediately sensitive to sulfur dioxide)
Xanthoria elegans (intermediately sensitive to sulfur dioxide)
Xanthoria fallax (sensitive to intermediately sensitive to sulfur dioxide)
Xanthoria polycarpa (sensitive to intermediately sensitive to sulfur dioxide)

Canyon Overlook Picnic Area (Site No. 3):

Candelariella vitellina (intermediately sensitive to sulfur dioxide and sensitive to fluoride)
Melanelia exasperatula (intermediately sensitive to sulfur dioxide)

Melanelia subelegantula (sensitive to sulfur dioxide)
Melanelia subolivacea (intermediately sensitive to ozone)
Peltigera rufescens (sensitive to intermediately sensitive to sulfur dioxide)
Physcia adscendens (intermediately sensitive to sulfur dioxide; sensitive to fluoride)
Physcia dubia (sensitive to intermediately sensitive to fluoride)
Physcia stellaris (intermediately sensitive to sulfur dioxide)
Rhizocarpon geographicum (sensitive to fluoride)
Rhizoplaca melanophthalma (sensitive to sulfur dioxide and NO_x/PAN)
Xanthoria fallax (sensitive to intermediately sensitive to sulfur dioxide)
Xanthoria polycarpa (sensitive to intermediately sensitive to sulfur dioxide)

Trail to Harper's Corner (Site No. 4):

Candelariella vitellina (intermediately sensitive to sulfur dioxide and sensitive to fluoride)
Peltigera rufescens (sensitive to intermediately sensitive to sulfur dioxide)
Physcia dubia (sensitive to intermediately sensitive to fluoride)
Rhizoplaca melanophthalma (sensitive to sulfur dioxide and NO_x/PAN)
Xanthoria elegans (intermediately sensitive to sulfur dioxide)

Hog Canyon (Site No. 5):

Melanelia subelegantula (sensitive to sulfur dioxide)
Physcia dubia (sensitive to intermediately sensitive to fluoride)
Physcia stellaris (intermediately sensitive to sulfur dioxide)
Rhizoplaca melanophthalma (sensitive to sulfur dioxide and NO_x/PAN)

Canyon east of Split Mountain Gorge (Site No. 6):

Caloplaca cerina (sensitive to intermediately sensitive to sulfur dioxide)
Candelariella vitellina (intermediately sensitive to sulfur dioxide and sensitive to fluoride)
Melanelia exasperatula (intermediately sensitive to sulfur dioxide)
Peltigera rufescens (sensitive to intermediately sensitive to sulfur dioxide)
Physcia dubia (sensitive to intermediately sensitive to fluoride)
Rhizoplaca melanophthalma (sensitive to sulfur dioxide and NO_x/PAN)
Xanthoria elegans (intermediately sensitive to sulfur dioxide)
Xanthoria fallax (sensitive to intermediately sensitive to sulfur dioxide)
Xanthoria polycarpa (sensitive to intermediately sensitive to sulfur dioxide)

Vicinity of Zenobia Peak (Site No. 7):

Caloplaca cerina (sensitive to intermediately sensitive to sulfur dioxide)
Candelariella vitellina (intermediately sensitive to sulfur dioxide and sensitive to fluoride)
Cladonia fimbriata (sensitive to intermediately sensitive to sulfur dioxide)

Hypocenomyce scalaris (intermediately sensitive to sulfur dioxide)
Lecanora saligna (intermediately sensitive to sulfur dioxide)
Leptogium saturninum (sensitive to sulfur dioxide)
Melanelia subelegantula (sensitive to sulfur dioxide)
Melanelia subolivacea (intermediately sensitive to ozone)
Phaeophyscia sciastra (sensitive to ozone)
Physcia caesia (intermediately sensitive to sulfur dioxide)
Physcia dubia (sensitive to intermediately sensitive to fluoride)
Physcia stellaris (intermediately sensitive to sulfur dioxide)
Physconia perisidiosa (intermediately sensitive to sulfur dioxide)
Rhizoplaca chrysoleuca (sensitive to sulfur dioxide and NO_x/PAN)
Rhizoplaca melanophthalma (sensitive to sulfur dioxide and NO_x/PAN)
Usnea hirta (sensitive to intermediately sensitive to sulfur dioxide)
Xanthoria candelaria (sensitive to ozone; intermediately sensitive to sulfur dioxide)
Xanthoria elegans (intermediately sensitive to sulfur dioxide)
Xanthoria fallax (sensitive to intermediately sensitive to sulfur dioxide)

Point of Pines (Site No. 8):

Rhizoplaca melanophthalma (sensitive to sulfur dioxide and NO_x/PAN)
Usnea hirta (sensitive to intermediately sensitive to sulfur dioxide)
Xanthoria elegans (intermediately sensitive to sulfur dioxide)

Vicinity of Deerlodge Park (Site No. 9):

Candelariella vitellina (intermediately sensitive to sulfur dioxide and sensitive to fluoride)
Physcia caesia (intermediately sensitive to sulfur dioxide)
Rhizoplaca chrysoleuca (sensitive to sulfur dioxide and NO_x/PAN)
Rhizoplaca melanophthalma (sensitive to sulfur dioxide and NO_x/PAN)
Xanthoria elegans (intermediately sensitive to sulfur dioxide)

Gates of Lodore (Site No. 10):

Caloplaca cerina (sensitive to intermediately sensitive to sulfur dioxide)
Physcia caesia (intermediately sensitive to sulfur dioxide)
Rhizoplaca chrysoleuca (sensitive to sulfur dioxide and NO_x/PAN)
Rhizoplaca melanophthalma (sensitive to sulfur and NO_x/PAN)
Xanthoria elegans (intermediately sensitive to sulfur dioxide)

Along Jones Hole Creek (Site No. 11):

Candelariella vitellina (intermediately sensitive to sulfur dioxide and sensitive to fluoride)
Melanelia exasperatula (intermediately sensitive to sulfur dioxide)
Physcia dubia (sensitive to intermediately sensitive to fluoride)
Rhizoplaca melanophthalma (sensitive to sulfur dioxide and NO_x/PAN)

Xanthoria candelaria (sensitive to ozone; intermediately sensitive to sulfur dioxide)

Xanthoria elegans (intermediately sensitive to sulfur dioxide)

Xanthoria fallax (sensitive to intermediately sensitive to sulfur dioxide)

Xanthoria polycarpa (sensitive to intermediately sensitive to sulfur dioxide)

Echo Park (Site No. 12):

Candelariella vitellina (intermediately sensitive to sulfur dioxide and sensitive to fluoride)

Physcia dubia (sensitive to intermediately sensitive to fluoride)

Rhizoplaca melanophthalma (sensitive to sulfur dioxide and NO_x/PAN)

Xanthoparmelia cumberlandia (sensitive to sulfur dioxide)

Xanthoria elegans (intermediately sensitive to sulfur dioxide)

Xanthoria polycarpa (sensitive to intermediately sensitive to sulfur dioxide)

Mouth of Sand Canyon (Site No. 13):

Candelariella vitellina (intermediately sensitive to sulfur dioxide and sensitive to fluoride)

Physcia dubia (sensitive to intermediately sensitive to fluoride)

Rhizoplaca melanophthalma (sensitive to sulfur dioxide and NO_x/PAN)

Xanthoria elegans (intermediately sensitive to sulfur dioxide)

Xanthoria polycarpa (sensitive to intermediately sensitive to sulfur dioxide)

Vicinity of Harding Hole Overlook (Site No. 14):

Candelariella vitellina (intermediately sensitive to sulfur dioxide and sensitive to fluoride)

Melanelia subolivacea (intermediately sensitive to ozone)

Physcia dubia (sensitive to intermediately sensitive to fluoride)

Rhizoplaca melanophthalma (sensitive to sulfur dioxide and NO_x/PAN)

Xanthoria elegans (intermediately sensitive to sulfur dioxide)

Vicinity of Mantle Ranch Turnoff (Site No. 15):

Candelariella vitellina (intermediately sensitive to sulfur dioxide and sensitive to fluoride)

Rhizoplaca melanophthalma (sensitive to sulfur dioxide and NO_x/PAN)

Xanthoria elegans (intermediately sensitive to sulfur dioxide)

Vicinity of Thanksgiving Point (Site No. 16):

Candelariella vitellina (intermediately sensitive to sulfur dioxide and sensitive to fluoride)

Caloplaca cerina (sensitive to intermediately sensitive to sulfur dioxide)

Melanelia subolivacea (intermediately sensitive to ozone)

Physcia caesia (intermediately sensitive to sulfur dioxide)
Physcia dubia (sensitive to intermediately sensitive to fluoride)
Physcia stellaris (intermediately sensitive to sulfur dioxide)
Rhizoplaca melanophthalma (sensitive to sulfur dioxide and NO_x/PAN)
Xanthoria elegans (intermediately sensitive to sulfur dioxide)
Xanthoria fallax (sensitive to intermediately sensitive to sulfur dioxide)
Xanthoria polycarpa (sensitive to intermediately sensitive to sulfur dioxide)

West of Haystack Rock Turnoff (Site No. 17):

Candelariella vitellina (intermediately sensitive to sulfur dioxide and sensitive to fluoride)
Melanelia exasperatula (intermediately sensitive to sulfur dioxide)
Melanelia subolivacea (intermediately sensitive to ozone)
Peltigera rufescens (sensitive to intermediately sensitive to sulfur dioxide)
Phaeophyscia sciastra (sensitive to ozone)
Physcia adscendens (intermediately sensitive to sulfur dioxide; sensitive to fluoride)
Physcia dubia (sensitive to intermediately sensitive to fluoride)
Physcia stellaris (intermediately sensitive to sulfur dioxide)
Rhizoplaca melanophthalma (sensitive to sulfur dioxide and NO_x/PAN)
Usnea subfloridana (sensitive to intermediately sensitive to sulfur dioxide)
Xanthoria candelaria (sensitive to ozone; intermediately sensitive to sulfur dioxide)
Xanthoria polycarpa (sensitive to intermediately sensitive to sulfur dioxide)

Vicinity of Haystack Rock (Site No. 18):

Candelariella vitellina (intermediately sensitive to sulfur dioxide and sensitive to fluoride)
Melanelia exasperatula (intermediately sensitive to sulfur dioxide)
Peltigera rufescens (sensitive to intermediately sensitive to sulfur dioxide)
Physcia dubia (sensitive to intermediately sensitive to fluoride)

CHECKLIST OF LICHEN SPECIES FROM SELECTED SITES IN DINOSAUR NATIONAL MONUMENT

Acarospora americana H. Magn.

Growth form: Crustose
 Substrate: Rock
 Site(s): Deerlodge Park
 Relative abundance: Rare to locally common
 Pollution sensitivity: Unknown
 Comments: None
 Deposition of specimens: BRY C-38469

Acarospora fuscata (Schrader) Arnold

Growth form: Crustose

Substrate: Rock

Site(s): along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock),
mouth of Sand Canyon, Deerlodge Park, vicinity of Mantle Ranch turnoff,
Gates of Lodore, Zenobia Peak, Point of Pines, Red Rock Nature Trail

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37423, BRY C-26167, BRY C-38482, BRY C-
26251, BRY C-38531, BRY C-38634, BRY C-38736, BRY C-38749Acarospora peltastica Zahlbr.

Growth form: Crustose

Substrate: Rock

Site(s): along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock),
Deerlodge Park, Gates of Lodore, Red Rock Nature Trail

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37415, BRY C-38507, BRY C-21781, BRY C-
21681, BRY C-38750Acarospora stapfiana (Müll. Arg.) Hue

Growth form: Crustose

Substrate: Rock

Site(s): Red Rock Nature Trail, Gates of Lodore, along Jones Hole Creek, vicinity
of Echo Park, Deerlodge Park, vicinity of Mantle Ranch turnoff

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: This species commonly grows over *Caloplaca trachyphylla*Deposition of specimens: BRY C-26070, BRY C-26130, BRY C-38478, BRY C-
26259, BRY C-21775, BRY C-38747Acarospora strigata (Nyl.) Jatta

Growth form: Crustose

Substrate: Rock

Site(s): Red Rock Nature Trail, vicinity of Thanksgiving Point, Canyon Overlook
Picnic Area, vicinity of Haystack Rock, along Jones Hole Creek, Harding
Hole Overlook, vicinity of Mantle Ranch turnoff, Gates of Lodore

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37377, BRY C-38378, BRY C-37491, BRY C-
26029, BRY C-26198, BRY C-26255, BRY C-21766, BRY C-38752

Acarospora utahensis Magnusson

Growth form: Crustose

Substrate: Rock

Site(s): Red Rock Nature Trail, Deerlodge Park

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38511, BRY C-38748

Amandinea punctata (Hoffm.) Coppins & Scheid.

Growth form: Crustose

Substrate: Bark, lignum

Site(s): Canyon Overlook Picnic Area, Gates of Lodore, Plug Hat Picnic Area,
Zenobia Peak, Hog Canyon, canyon east of Split Mountain Gorge

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38403, BRY C-21616, BRY C-38576, BRY C-
38581, BRY C-38638, BRY C-38664, BRY C-38717, BRY C-38814, BRY
C-38815, BRY C-38845Aspicilia calcarea L. Mudd

Growth form: Crustose

Substrate: Rock

Site(s): vicinity of Thanksgiving Point, canyon east of Split Mountain Gorge

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37359, BRY C-38812

Aspicilia cinerea (L.) Körber

Growth form: Crustose

Substrate: Rock

Site(s): Gates of Lodore, Plug Hat Picnic Area, Zenobia Peak, Hog Canyon

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-21777, BRY C-21774, BRY C-38543, BRY C-
38636, BRY C-38708

Aspicilia desertorum (Kremp.) Mereschk.

Growth form: Crustose

Substrate: Rock, small pebbles on soil

Site(s): Canyon Overlook Picnic Area, Gates of Lodore, vicinity of Thanksgiving Point, along Mantle Ranch Road (five miles west of turnoff to Haystack Rock), Deerlodge Park, Plug Hat Picnic Area

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37365, BRY C-37422, BRY C-38380, BRY C-38462, BRY C-38487, BRY C-21678, BRY C-21763, BRY C-38544

Aspicilia fruticulosa (Eversm.) Flagey

Growth form: Fruticose

Substrate: Soil (semi-vagrant)

Site(s): Harding Hole Overlook

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-26205

Aspicilia hispida Mereschk.

Growth form: Fruticose

Substrate: Soil (semi-attached - vagrant)

Site(s): Canyon Overlook Picnic Area, Red Rock Nature Trail, Gates of Lodore, vicinity of Thanksgiving Point

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37347, BRY C-38381, BRY C-21782, BRY C-21603

Aspicilia lignicola (Anzi) Hue

Growth form: Crustose

Substrate: Lignum

Site(s): vicinity of Thanksgiving Point, along Mantle Ranch Road (five miles west of turnoff to Haystack Rock), vicinity of Haystack Rock, canyon east of Split Mountain Gorge

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37398, BRY C-37460, BRY C-37503, BRY C-38813

Aspicilia terrestris Tomin

Growth form: Crustose-fruticose

Substrate: Soil

Site(s): Gates of Lodore, Hog Canyon, Red Rock Nature Trail

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-21605, BRY C-21606, BRY C-21799, BRY C-38709, BRY C-38753

Biatora vernalis (L.) Fr.

Growth form: Crustose

Substrate: Lignum

Site(s): along Mantle Ranch Road (five mile west of turnoff to Haystack Rock)

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37458a

Buellia elegans Poelt

Growth form: Crustose (with lobate margins)

Substrate: Soil

Site(s): vicinity of Echo Park

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-26113

Caloplaca arizonica H. Magn.

Growth form: Crustose

Substrate: Lignum, bark

Site(s): Plug Hat Picnic Area, vicinity of Thanksgiving Point, vicinity of Haystack Rock, along Jones Hole Creek, mouth of Sand Canyon, Deerlodge Park, Harding Hole Overlook, vicinity of Mantle Ranch turnoff, trail to Harper's Corner, Gates of Lodore, Hog Canyon, canyon east of Split Mountain Gorge

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37395, BRY C-37498, BRY C-26010, BRY C-26146, BRY C-38483, BRY C-26214, BRY C-26243, BRY C-38516, BRY C-21614, BRY C-21819, BRY C-38545, BRY C-38710, BRY C-38816

Caloplaca atroalba (Tuck.) Zahlbr.

Growth form: Crustose
Substrate: Rock
Site(s): Canyon Overlook Picnic Area
Relative abundance: Rare
Pollution sensitivity: Unknown
Comments: None
Deposition of specimens: BRY C-38388

Caloplaca cerina (Ehrh. ex Hedwig) Th. Fr.

Growth form: Crustose
Substrate: Lignum
Site(s): Plug Hat Picnic Area, vicinity of Thanksgiving Point, Gates of Lodore, Zenobia Peak, canyon east of Split Mountain Gorge
Relative abundance: Rare
Pollution sensitivity: Sensitive to intermediately sensitive to sulfur dioxide (Wetmore 1987)
Comments: None
Deposition of specimens: BRY C-37393b, BRY C-21615, BRY C-38546, BRY C-38640, BRY C-38817

Caloplaca chrysophthalma Degel.

Growth form: Crustose
Substrate: Bark
Site(s): canyon east of Split Mountain Gorge
Relative abundance: Rare
Pollution sensitivity: Unknown
Comments: None
Deposition of specimens: BRY C-38818

Caloplaca cinnabarina (Ach.) Zahlbr.

Growth form: Crustose
Substrate: Rock
Site(s): mouth of Sand Canyon
Relative abundance: Rare
Pollution sensitivity: Unknown
Comments: None
Deposition of specimens: BRY C-26174

Caloplaca cladodes (Tuck.) Zahlbr.

Growth form: Minutely fruticose

Substrate: Soil over rock, soil over lignum

Site(s): Canyon Overlook Picnic Area, Plug Hat Picnic Area, along Mantle Ranch Road (five miles west of turnoff to Haystack Rock), Deerlodge Park, vicinity of Echo Park, Harding Hole Overlook

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37412, BRY C-38389, BRY C-38448, BRY C-26131, BRY C-26203, BRY C-38548, BRY C-38549

Caloplaca decipiens (Arnold) Blomb. & Forss.

Growth form: Crustose with effigurate margins

Substrate: Rock

Site(s): Canyon Overlook Picnic Area, Red Rock Nature Trail, along Mantle Ranch Road (five miles west of turnoff to Haystack Rock), mouth of Sand Canyon

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37452, BRY C-26180, BRY C-38754

Caloplaca durietzii H. Magn.

Growth form: Crustose

Substrate: Lignum

Site(s): mouth of Sand Canyon, Deerlodge Park, Harding Hole Overlook, vicinity of Mantle Ranch turnoff, Gates of Lodore

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-26141, BRY C-38474, BRY C-26217, BRY C-26235, BRY C-21618

Caloplaca epithallina Lynge

Growth form: Crustose (scant) epiphytic on other lichen species

Substrate: Over thalli of *Lecanora novomexicana* and *Rhizoplaca melanophthalma*

Site(s): Gates of Lodore

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-21607, BRY C-21684

Caloplaca fraudans (Th. Fr.) H. Olivier

Growth form: Crustose

Substrate: Rock

Site(s): Canyon Overlook Picnic Area, vicinity of Haystack Rock, Gates of
Lodore, Zenobia Peak

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38390, BRY C-37485, BRY C-38533, BRY C-
38642Caloplaca microphyllina (Tuck.) Hasse

Growth form: Crustose

Substrate: Lignum

Site(s): Plug Hat Picnic Area, vicinity of Haystack Rock

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37502, BRY C-21504

Caloplaca modesta (Zahlbr.) FinkGrowth form: Crustose (\pm with effigurate margins)

Substrate: Rock

Site(s): vicinity of Thanksgiving Point, Plug Hat Picnic Area, Zenobia Peak

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37353, BRY C-38547, BRY C-38643

Caloplaca pinicola H. Magn.

Growth form: Crustose (scant to absent)

Substrate: Lignum

Site(s): Gates of Lodore

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-21612

Caloplaca sideritis (Tuck.) Zahlbr.

Growth form: Crustose
 Substrate: Rock
 Site(s): canyon east of Split Mountain Gorge
 Relative abundance: Rare
 Pollution sensitivity: Unknown
 Comments: None
 Deposition of specimens: BRY C-38819

Caloplaca tirolensis Zahlbr.

Growth form: Crustose (scant)
 Substrate: Moss
 Site(s): along Mantle Ranch Road (five miles west of turnoff to Haystack Road)
 Relative abundance: Rare
 Pollution sensitivity: Unknown
 Comments: None
 Deposition of specimens: BRY C-37442b

Caloplaca tominii Savicz

Growth form: Crustose
 Substrate: Soil
 Site(s): canyon east of Split Mountain Gorge
 Relative abundance: Rare to locally common
 Pollution sensitivity: Unknown
 Comments: None
 Deposition of specimens: BRY C-38891

Caloplaca trachyphylla (Tuck.) Zahlbr.

Growth form: Crustose with effigurate margins
 Substrate: Rock
 Site(s): Plug Hat Picnic Area, Red Rock Nature Trail, Gates of Lodore, vicinity of Thanksgiving Point, along Mantle Ranch Road (five miles west of turnoff to Haystack Rock), vicinity of Echo Park, mouth of Sand Canyon, Deerlodge Park, Harding Hole Overlook, vicinity of Mantle Ranch turnoff
 Relative abundance: Locally common to abundant
 Pollution sensitivity: Unknown
 Comments: None
 Deposition of specimens: BRY C-37380, BRY C-37454, BRY C-26118, BRY C-26166, BRY C-38472, BRY C-26200, BRY C-26258, BRY C-21762, BRY C-38755

Caloplaca ulmorum (Fink) Fink

Growth form: Crustose (scant)
Substrate: Moss
Site(s): Gates of Lodore
Relative abundance: Rare
Pollution sensitivity: Unknown
Comments: None
Deposition of specimens: BRY C-21795

Candelariella aurella (Hoffm.) Zahlbr.

Growth form: Crustose (scant)
Substrate: Moss
Site(s): Deerlodge Park
Relative abundance: Rare
Pollution sensitivity: Unknown
Comments: None
Deposition of specimens: BRY C-38496

Candelariella deflexa (Nyl.) Zahlbr.

Growth form: Crustose (scant)
Substrate: Bark, lignum
Site(s): along Mantle Ranch Road (five miles west of turnoff to Haystack Rock),
vicinity of Echo Park, Plug Hat Picnic Area, canyon east of Split Mountain
Gorge
Relative abundance: Rare to locally common
Pollution sensitivity: Unknown
Comments: None
Deposition of specimens: BRY C-37475, BRY C-26123, BRY C-38555, BRY C-
38821

Candelariella placodizans (Nyl.) H. Magn.

Growth form: Crustose (scant)
Substrate: Soil
Site(s): Canyon Overlook Picnic Area
Relative abundance: Rare
Pollution sensitivity: Unknown
Comments: None
Deposition of specimens: BRY C-38394

Candelariella rosulans (Müll. Arg.) Zahlbr.

Growth form: Crustose

Substrate: Soil over rock, rock

Site(s): Red Rock Nature Trail, along Mantle Ranch Road (five miles west of turnoff to Haystack Rock), Canyon Overlook Picnic Area, vicinity of Echo Park, mouth of Sand Canyon, Harding Hole Overlook, Gates of Lodore, Plug Hat Picnic Area, Zenobia Peak, Point of Pines, canyon east of Split Mountain Gorge

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37413, BRY C-38396, BRY C-26120, BRY C-26135, BRY C-26197, BRY C-21682, BRY C-21780, BRY C-21804, BRY C-21805, BRY C-38554, BRY C-38644, BRY C-38737, BRY C-38756, BRY C-38822

Candelariella terrigena Räsänen

Growth form: Crustose

Substrate: Soil/moss over rock/lignum

Site(s): vicinity of Thanksgiving Point, Plug Hat Picnic Area

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37344, BRY C-38553

Candelariella vitellina (Hoffm.) Müll. Arg.

Growth form: Crustose

Substrate: Lignum, bark, soil over rock, rock

Site(s): Canyon Overlook Picnic Area, vicinity of Thanksgiving Point, along Mantle Ranch Road (five miles west of turnoff to Haystack Rock), vicinity of Haystack Rock, Deerlodge Park, along Jones Hole Creek, vicinity of Echo Park, mouth of Sand Canyon, Harding Hole Overlook, vicinity of Mantle Ranch turnoff, Echo Park Overlook, trail to Harper's Corner, Zenobia Peak, canyon east of Split Mountain Gorge

Relative abundance: Locally common

Pollution sensitivity: Intermediately sensitive to sulfur dioxide, sensitive to fluoride (Ryan 1990)

Comments: None

Deposition of specimens: BRY C-37388e, BRY C-37402, BRY C-37459, BRY C-38395, BRY C-38397, BRY C-37480, BRY C-38456, BRY C-26026, BRY C-26084, BRY C-26138, BRY C-26206, BRY C-26256, BRY C-38515, BRY C-38517, BRY C-38646, BRY C-38647, BRY C-38820, BRY C-38823

Catapyrenium daedaleum (Kremp.) Stein

Growth form: Squamulose
 Substrate: Soil
 Site(s): Gates of Lodore
 Relative abundance: Rare
 Pollution sensitivity: Unknown
 Comments: None
 Deposition of specimens: BRY C-21670

Catapyrenium zahibbruckneri (Hasse) Thomson

Growth form: Crustose
 Substrate: Rock
 Site(s): Canyon Overlook Picnic Area, along Mantle Ranch Road (five miles west of turnoff to Haystack Rock), vicinity of Haystack Rock, Harding Hole Overlook, Plug Hat Picnic Area, canyon east of Split Mountain Gorge
 Relative abundance: Rare
 Pollution sensitivity: Unknown
 Comments: None
 Deposition of specimens: BRY C-37427, BRY C-37487, BRY C-26196, BRY C-38551, BRY C-38824

Cladonia cariosa (Ach.) Sprengel

Growth form: Squamulose with podetia
 Substrate: Moss over rock
 Site(s): Zenobia Peak
 Relative abundance: Rare to locally common
 Pollution sensitivity: Unknown
 Comments: None
 Deposition of specimens: BRY C-38649

Cladonia fimbriata (L.) Fr.

Growth form: Squamulose with podetia
 Substrate: Soil, moss, moss over rock
 Site(s): Zenobia Peak
 Relative abundance: Rare to locally common
 Pollution sensitivity: Sensitive to intermediately sensitive to sulfur dioxide (Wetmore 1987)
 Comments: None
 Deposition of specimens: BRY C-38648, BRY C-38650

Cladonia pyxidata (L.) Hoffm.

Growth form: Squamulose with podetia

Substrate: Soil, moss over rock

Site(s): along Mantle Ranch Road (five miles west of turnoff to Haystack Rock),
moss over rock, Zenobia Peak

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37408, BRY C-38651, BRY C-38691

Collema coccophorum Tuck.

Growth form: Foliose

Substrate: Soil over rock

Site(s): Red Rock Nature Trail, vicinity of Thanksgiving Point, canyon east of
Split Mountain Gorge

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37362, BRY C-38764, BRY C-38868

Collema crispum (Hudson) F.H. Wigg.

Growth form: Foliose

Substrate: Moss over rock, rock

Site(s): along Mantle Ranch Road (five miles west of turnoff to Haystack Road),
Hog Canyon, canyon east of Split Mountain Gorge

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37449, BRY C-38712b, BRY C-38829

Collema cristatum var. marginale (Hudson) Degel.

Growth form: Foliose

Substrate: Rock, moss over rock

Site(s): Red Rock Nature Trail, vicinity of Thanksgiving Point, mouth of Sand
Canyon, Gates of Lodore, Hog Canyon, canyon east of Split Mountain
Gorge

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37375, BRY C-26134, BRY C-21785, BRY C-
21598, BRY C-21702, BRY C-38732, BRY C-38760, BRY C-38828

Collema fuscovirens (With.) J.R. Laundon

Growth form: Foliose

Substrate: Rock

Site(s): along Jones Hole Creek, Gates of Lodore, Plug Hat Picnic Area, Hog Canyon, canyon east of Split Mountain Gorge

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-26020, BRY C-21600, BRY C-38557, BRY C-38712c, BRY C-38826

Collema polycarpon Hoffm.

Growth form: Foliose

Substrate: Rock

Site(s): Gates of Lodore, Zenobia Peak, Hog Canyon, canyon east of Split Mountain Gorge

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-21599, BRY C-21797, BRY C-38652, BRY C-38712a, BRY C-38827

Collema tenax (Sw.) Ach.

Growth form: Foliose

Substrate: Soil over rock, soil

Site(s): vicinity of Thanksgiving Point, along Mantle Ranch Road (five miles west of turnoff to Haystack Rock), Canyon Overlook Picnic Area, vicinity of Haystack Rock, along Jones Hole Creek, vicinity of Echo Park, mouth of Sand Canyon, Deerlodge Park, Harding Hole Overlook, Gates of Lodore, Plug Hat Picnic Area, Hog Canyon, Red Rock Nature Trail, canyon east of Split Mountain Gorge

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37345, BRY C-37431, BRY C-38399, BRY C-37486, BRY C-26040, BRY C-26106, BRY C-26153, BRY C-38494, BRY C-26185, BRY C-21806, BRY C-38559, BRY C-38730, BRY C-38759, BRY C-38867

Dermatocarpon intestiniforme (Körber) Hasse

Growth form: Foliose (umbilicate)

Substrate: Rock

Site(s): Plug Hat Picnic Area, Red Rock Nature Trail, Gates of
Lodore, canyon east of Split Mountain Gorge

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-21709, BRY C-38561, BRY C-38762, BRY C-
38831Dermatocarpon miniatum (L.) Mann

Growth form: Foliose (umbilicate)

Substrate: Rock

Site(s): Hog Canyon, Plug Hat Picnic Area, Red Rock Nature Trail, along Mantle
Ranch Road (five miles west of turnoff to Haystack Rock), Canyon
Overlook Picnic Area, Deerlodge Park, Gates of Lodore, Zenobia Peak,
canyon east of Split Mountain Gorge

Relative abundance: Locally common to abundant

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37444, BRY C-38400, BRY C-38454, BRY C-
21710, BRY C-38560, BRY C-38654, BRY C-38713, BRY C-38763, BRY
C-38832, BRY C-38833, BRY C-38834Dermatocarpon moulinsii (Mont.) Zahlbr.

Growth form: Foliose (umbilicate)

Substrate: Rock

Site(s): canyon east of Split Mountain Gorge

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38830

Dermatocarpon reticulatum H. Magn.

Growth form: Foliose (umbilicate)

Substrate: Rock

Site(s): Hog Canyon, Plug Hat Picnic Area, along Jones Hole Creek, vicinity of
Echo Park, mouth of Sand Canyon, Zenobia Peak

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-26019, BRY C-26081, BRY C-26175, BRY C-
38653

Dermatocarpon vellereum Zschacke

Growth form: Foliose (umbilicate)

Substrate: Rock

Site(s): Hog Canyon, canyon east of Split Mountain Gorge

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: This taxon is a new species record for Utah.

Deposition of specimens: BRY C-38714

Dimelaena oreina (Ach.) Norman

Growth form: Crustose (with effigurate margins)

Substrate: Rock

Site(s): Deerlodge Park, Gates of Lodore

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38479, BRY C-38536

Diploschistes actinostomus (Ach.) Zahlbr.

Growth form: Crustose

Substrate: Rock

Site(s): Deerlodge Park, vicinity of Echo Park, Zenobia Peak, Red Rock Nature Trail, canyon east of Split Mountain Gorge

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38461, BRY C-26095, BRY C-38655, BRY C-38765, BRY C-38835

Diploschistes muscorum (Scop.) R. Sant.

Growth form: Crustose

Substrate: Soil

Site(s): along Mantle Ranch Road (five miles west of turnoff to Haystack Rock), vicinity of Haystack Rock

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37405, BRY C-37479

Diploschistes scruposus (Schreber) Norman

Growth form: Crustose

Substrate: Rock

Site(s): along Mantle Ranch Road (five miles west of turnoff to Haystack Rock),
Plug Hat Picnic Area, Zenobia Peak, Red Rock Nature Trail, canyon east of
Split Mountain Gorge

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37446, BRY C-38562, BRY C-38656, BRY C-
38766, BRY C-38836Diplotomma alboatrum (Hoffm.) Flotow

Growth form: Crustose

Substrate: Rock

Site(s): Canyon Overlook Picnic Area, Red Rock Nature Trail

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38401, BRY C-38771

Endocarpon pulvinatum Th. Fr.

Growth form: Squamulose

Substrate: Rock

Site(s): Zenobia Peak

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38658

Endocarpon pusillum Hedwig

Growth form: Squamulose

Substrate: Soil/moss over rock

Site(s): along Mantle Ranch Road (five miles west of turnoff to Haystack Rock),
Deerlodge Park, Plug Hat Picnic Area

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37430, BRY C-38501, BRY C-38563

Flavopunctelia sore dica (Nyl.) Hale

Growth form: Foliose
 Substrate: Bark
 Site(s): vicinity of Thanksgiving Point
 Relative abundance: Rare to locally common
 Pollution sensitivity: Unknown
 Comments: None
 Deposition of specimens: BRY C-37387

Fulgensia bracteata (Hoffm.) Räsänen

Growth form: Crustose
 Substrate: Soil
 Site(s): vicinity of Haystack Rock, Gates of Lodore
 Relative abundance: Rare
 Pollution sensitivity: Unknown
 Comments: None
 Deposition of specimens: BRY C-37482, BRY C-21808

Fulgensia desertorum (Tomin) Poelt

Growth form: Crustose with effigurate margins
 Substrate: Soil
 Site(s): vicinity of Thanksgiving Point, Deerlodge Park, Red Rock Nature Trail
 Relative abundance: Locally common
 Pollution sensitivity: Unknown
 Comments: None
 Deposition of specimens: BRY C-37363, BRY C-38505, BRY C-38810

Fulgensia fulgens (Sw.) Elenkin

Growth form: Crustose with effigurate margins
 Substrate: Soil
 Site(s): along Jones Hole Creek, Harding Hole Overlook, Gates of Lodore
 Relative abundance: Rare to locally common
 Pollution sensitivity: Unknown
 Comments: None
 Deposition of specimens: BRY C-26057, BRY C-26186, BRY C-21807, BRY C-21676

Glypholecia scabra (Pers.) Müll. Arg.

Growth form: Foliose (umbilicate)

Substrate: Rock

Site(s): Hog Canyon, Red Rock Nature Trail, canyon east of Split Mountain
Gorge, Gates of Lodore, Plug Hat Picnic Area

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-21596, BRY C-21786, BRY C-21817, BRY C-
38715, BRY C-38769, BRY C-38837Heppia lutosa (Ach.) Nyl.

Growth form: Squamulose

Substrate: Soil over rock

Site(s): Hog Canyon, Gates of Lodore, Red Rock Nature Trail, canyon east of
Split Mountain Gorge

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-21812, BRY C-38716, BRY C-21501, BRY C-
38869Heteropladidium acarosporoides (Zahlbr.) Breuss

Growth form: Crustose

Substrate: Rock

Site(s): Canyon Overlook Picnic Area

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38398

Hypocenomyce scalaris (Ach.) Choisy

Growth form: Squamulose

Substrate: Burned wood

Site(s): canyon east of Split Mountain Gorge

Relative abundance: Rare to locally common

Pollution sensitivity: Intermediately sensitive to sulfur dioxide (Ryan 1990)

Comments: None

Deposition of specimens: BRY C-38838

Lecanora argopholis (Ach.) Ach.

Growth form: Crustose

Substrate: Rock, lignum

Site(s): Zenobia Peak, Plug Hat Picnic Area, Red Rock Nature Trail, vicinity of Thanksgiving Point, along Mantle Ranch Road (five miles west of turnoff to Haystack Rock), Deerlodge Park, along Jones Hole Creek, vicinity of Echo Park, Harding Hole Overlook, vicinity of Mantle Ranch turnoff, Gates of Lodore, canyon east of Split Mountain Gorge

Relative abundance: Locally common to abundant

Pollution sensitivity: Unknown

Comments: Lignum is an unusual substrate for this species.

Deposition of specimens: BRY C-37349, BRY C-37453, BRY C-38444, BRY C-26037, BRY C-26078, BRY C-26224, BRY C-26247, BRY C-38538, BRY C-38569, BRY C-38661, BRY C-38841

Lecanora caesiorubella ssp. saximontana Imsh. & BrodoGrowth form: Crustose (margin \pm effigurate)

Substrate: Lignum

Site(s): Deerlodge Park, Gates of Lodore, Plug Hat Picnic Area

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38510, BRY C-21613, BRY C-38574

Lecanora cenisia Ach.

Growth form: Crustose

Substrate: Rock, lignum

Site(s): Canyon Overlook Picnic Area, vicinity of Thanksgiving Point, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), vicinity of Haystack Rock, Deerlodge Park, Zenobia Peak, Red Rock Nature Trail

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: Lignum is an unusual substrate for this species

Deposition of specimens: BRY C-37392, BRY C-37400, BRY C-38402, BRY C-37426, BRY C-37504, BRY C-38485, BRY C-38662, BRY C-38773

Lecanora crenulata Hook.

Growth form: Crustose (scant to absent)

Substrate: Rock

Site(s): Plug Hat Picnic Area, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), vicinity of Echo Park, Harding Hole Overlook

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37451, BRY C-26100, BRY C-26219, BRY C-38567, BRY C-38751

Lecanora dispersa (Pers.) Sommerf.

Growth form: Crustose (scant to absent)

Substrate: Rock

Site(s): Plug Hat Picnic Area

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38568

Lecanora garovaglii (Körber) Zahlbr.

Growth form: Crustose with effigurate margins

Substrate: Rock, lignum

Site(s): along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), vicinity of Haystack Rock, Deerlodge Park, Gates of Lodore, Red Rock Nature Trail

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: Lignum is an unusual substrate for this species.

Deposition of specimens: BRY C-37451, BRY C-37420, BRY C-37500, BRY C-38471, BRY C-21685, BRY C-38770, BRY C-38774

Lecanora hageni (Ach.) Ach.

Growth form: Crustose to obsolete

Substrate: Lignum, moss over soil

Site(s): Plug Hat Picnic Area, canyon east of Split Mountain Gorge, vicinity of Thanksgiving Point, Red Rock Nature Trail, canyon east of Split Mountain Gorge

Relative abundance: Rare to common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37393a, BRY C-38571, BRY C-38775, BRY C-38839

Lecanora meridionalis H. Magn.

Growth form: Crustose
Substrate: Lignum
Site(s): Plug Hat Picnic Area
Relative abundance: Rare to locally common
Pollution sensitivity: Unknown
Comments: None
Deposition of specimens: BRY C-38575

Lecanora muralis (Schreber) Rabenh.

Growth form: Crustose with effigurate margin
Substrate: Rock, lignum
Site(s): Red Rock Nature Trail, vicinity of Thanksgiving Point, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), Deerlodge Park, along Jones Hole Creek, Harding Hole Overlook, vicinity of Mantle Ranch turnoff, Gates of Lodore, Plug Hat Picnic Area
Relative abundance: Locally common
Pollution sensitivity: Tolerant of sulfur dioxide (Ryan 1990)
Comments: None
Deposition of specimens: BRY C-37360, BRY C-37424, BRY C-38460, BRY C-26034, BRY C-26223, BRY C-26233, BRY C-38540, BRY C-38572

Lecanora novomexicana H. Magn.

Growth form: Crustose with effigurate margins
Substrate: Rock
Site(s): Gates of Lodore, vicinity of Thanksgiving Point, Deerlodge Park, Plug Hat Picnic Area
Relative abundance: Locally common
Pollution sensitivity: Unknown
Comments: Lignum is an unusual substrate for this species
Deposition of specimens: BRY C-37367, BRY C-38480, BRY C-21683, BRY C-38566, BRY C-38572

Lecanora phaedrophthalma Poelt

Growth form: Crustose
Substrate: Rock
Site(s): vicinity of Echo Park, mouth of Sand Canyon, Harding Hole Overlook
Relative abundance: Rare
Pollution sensitivity: Unknown
Comments: None
Deposition of specimens: BRY C-26129, BRY C-26163, BRY C-26225

Lecanora piniperda Körber

Growth form: Crustose (scant to absent)

Substrate: Lignum

Site(s): Gates of Lodore

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-21611

Lecanora saligna (Schrader) Zahlbr.

Growth form: Crustose (scant to absent)

Substrate: Bark

Site(s): Zenobia Peak

Relative abundance: Rare to locally common

Pollution sensitivity: Intermediately sensitive to sulfur dioxide (Wetmore 1987)

Comments: None

Deposition of specimens: BRY C-38663

Lecanora thallophila H. Magn.

Growth form: Crustose (scant to absent)

Substrate: over thalli of *Dermatocarpon* and *Physcia* spp.

Site(s): Plug Hat Picnic Area, canyon east of Split Mountain Gorge, Gates of Lodore, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock)

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37445, BRY C-21699, BRY C-38573, BRY C-38843

Lecanora valesiaca (Müll. Arg.) Stizenb.

Growth form: Crustose (with effigurate margins)

Substrate: Rock

Site(s): vicinity of Echo Park

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-26112

Lecidea atrobrunnea (Ramond ex Lam. & DC.) Schaerer

Growth form: Crustose

Substrate: Rock

Site(s): vicinity of Thanksgiving Point, Canyon Overlook Picnic Area, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), mouth of Sand Canyon, Plug Hat Picnic Area, Point of Pines

Relative abundance: Locally common

Pollution sensitivity: Tolerant of sulfur dioxide (Ryan1990)

Comments: None

Deposition of specimens: BRY C-37350, BRY C-38404, BRY C-37421, BRY C-26162, BRY C-38580, BRY C-38738

Lecidea leucothallina Arnold

Growth form: Crustose

Substrate: Rock

Site(s): Zenobia Peak

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38669

Lecidea tessellata Flörke

Growth form: Crustose (scant to well-developed)

Substrate: Rock

Site(s): vicinity of Thanksgiving Point, Canyon Overlook Picnic Area, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), Deerlodge Park, vicinity of Haystack Rock, along Jones Hole Creek, vicinity of Echo Park, mouth of Sand Canyon, Harding Hole Overlook, vicinity of Mantle Ranch turnoff, Gates of Lodore, Zenobia Peak, Red Rock Nature Trail

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37374, BRY C-38406, BRY C-37419, BRY C-38446, BRY C-37484, BRY C-26035, BRY C-26094, BRY C-26156, BRY C-26209, BRY C-26248, BRY C-21688, BRY C-38666, BRY C-38777

Lecidella euphorea (Flörke) Hertel

Growth form: Crustose

Substrate: Lignum

Site(s): vicinity of Thanksgiving Point, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), vicinity of Haystack Rock, Gates of Lodore, Plug Hat Picnic Area

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37388b, BRY C-37458b, BRY C-37509, BRY C-21617, BRY C-38577

Lecidella stigmathea (Ach.) Hertel & Leuck.

Growth form: Crustose

Substrate: Rock

Site(s): vicinity of Thanksgiving Point, Canyon Overlook Picnic Area, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), along Jones Hole Creek, Gates of Lodore, Zenobia Peak, Red Rock Nature Trail

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37356, BRY C-38405, BRY C-37414, BRY C-26052, BRY C-21765, BRY C-38667, BRY C-38779

Leptogium intermedium (Arnold) Arnold

Growth form: Foliose

Substrate: Soil

Site(s): vicinity of Thanksgiving Point

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37378

Leptogium saturninum (Dickson) Nyl.

Growth form: Foliose

Substrate: Rock

Site(s): Zenobia Peak

Relative abundance: Locally common

Pollution sensitivity: Sensitive to sulfur dioxide (Mc Cune & Geiser 1997)

Comments: None

Deposition of specimens: BRY C-38670

Lobothallia alphoplaca (Wahlenb.) Hafeliner

Growth form: Crustose with effigurate margins

Substrate: Rock

Site(s): vicinity of Thanksgiving Point, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), Deerlodge Park, along Jones Hole Creek, Harding Hole Overlook, Gates of Lodore, Plug Hat Picnic Area

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37373, BRY C-37447, BRY C-38445, BRY C-26036, BRY C-26226, BRY C-21768, BRY C-21679, BRY C-21680, BRY C-38542

Megaspora verrucosa (Ach.) Hafellner & V. Wirth

Growth form: Crustose

Substrate: Detritus over rock, bark, moss over bark

Site(s): Zenobia Peak, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), trail to Harper's Corner, Plug Hat Picnic Area, canyon east of Split Mountain Gorge

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37438, BRY C-38520, BRY C-38582, BRY C-38584, BRY C-38671, BRY C-38847

Melanelia elegantula (Zahlbr.) Essl.

Growth form: Foliose

Substrate: Rock, lignum, moss over rock, moss over bark

Site(s): vicinity of Thanksgiving Point, along Jones Hole Creek, vicinity of Echo Park, mouth of Sand Canyon, Plug Hat Picnic Area, Zenobia Peak, canyon east of Split Mountain Gorge

Relative abundance: Rare to locally common

Pollution sensitivity: Tolerant of ozone (Ryan 1990)

Comments: None

Deposition of specimens: BRY C-37368, BRY C-26002, BRY C-26083, BRY C-26136, BRY C-38585, BRY C-38672, BRY C-38849

Melanelia exasperatula (Nyl.) Essl.

Growth form: Foliose

Substrate: Lignum, bark

Site(s): Canyon Overlook Picnic Area, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), vicinity of Haystack Rock, along Jones Hole Creek, Plug Hat Picnic Area, canyon east of Split Mountain Gorge

Relative abundance: Locally common

Pollution sensitivity: Intermediately sensitive to sulfur dioxide (Ryan 1990)

Comments: None

Deposition of specimens: BRY C-38414, BRY C-37470, BRY C-37497, BRY C-26003, BRY C-38586, BRY C-38848

Melanelia subelegantula (Essl.) Essl.

Growth form: Foliose

Substrate: Bark, lignum

Site(s): Canyon Overlook Picnic Area, Zenobia Peak, Hog Canyon

Relative abundance: Locally common to abundant

Pollution sensitivity: Sensitive to sulfur dioxide (Mc Cune & Geiser 1997)

Comments: None

Deposition of specimens: BRY C-38411, BRY C-38413, BRY C-38673, BRY C-38675, BRY C-38718

Melanelia subolivacea (Nyl.) Essl.

Growth form: Foliose

Substrate: Bark, lignum, small conifer branches

Site(s): Canyon Overlook Picnic Area, vicinity of Thanksgiving Point, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), Harding Hole Overlook, Plug Hat Picnic Area, Zenobia Peak

Relative abundance: Locally common to abundant

Pollution sensitivity: Intermediately sensitive to ozone (Ryan 1990)

Comments: None

Deposition of specimens: BRY C-37386, BRY C-38409, BRY C-38412, BRY C-37472, BRY C-26212, BRY C-38589, BRY C-38674, BRY C-38676

Melanelia tominii (Oksner) Essl.

Growth form: Foliose

Substrate: Rock

Site(s): Deerlodge Park, Gates of Lodore, Zenobia Peak, Red Rock Nature Trail

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38443, BRY C-21690, BRY C-38677, BRY C-38782

Neofuscelia pustulosa (Essl.) Essl.

Growth form: Foliose

Substrate: Rock

Site(s): Deerlodge Park, Gates of Lodore

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38458, BRY C-21707

Peccania arizonica (Tuck.) Herre

Growth form: Crustose to minutely fruticose

Substrate: Soil

Site(s): Deerlodge Park

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38489

Peccania subnigra (de Lesd.) Wetmore

Growth form: Minutely fruticose

Substrate: Soil

Site(s): Red Rock Nature Trail

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38761

Peltigera canina (L.) Willd.

Growth form: Foliose

Substrate: Soil, moss over rock

Site(s): Canyon Overlook Picnic Area, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), Zenobia Peak

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38415, BRY C-37409, BRY C-38680

Peltigera praetextata (Flörke ex Sommerf.) Zopf

Growth form: Foliose

Substrate: Soil/moss over rock, soil

Site(s): Plug Hat Picnic Area, canyon east of Split Mountain Gorge

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38602, BRY C-38603, BRY C-38851

Peltigera rufescens (Weiss) Humb.

Growth form: Foliose

Substrate: Soil

Site(s): Canyon Overlook Picnic Area, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), vicinity of Haystack Rock, trail to Harper's Corner, canyon east of Split Mountain Gorge

Relative abundance: Locally common

Pollution sensitivity: Sensitive to intermediately sensitive to sulfur dioxide (McCune and Geiser 1997)

Comments: None

Deposition of specimens: BRY C-38415, BRY C-37406, BRY C-37478, BRY C-38521, BRY C-38850

Pertusaria saximontana Wetmore

Growth form: Crustose

Substrate: Lignum

Site(s): Plug Hat Picnic Area

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38604

Phaeophyscia decolor (Kashiw.) Essl.

Growth form: Foliose

Substrate: Moss, rock

Site(s): along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), Zenobia Peak

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37442a, BRY C-38678

Phaeophyscia sciastra (Ach.) Moberg

Growth form: Foliose

Substrate: Moss over rock, rock

Site(s): along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), Zenobia Peak

Relative abundance: Rare

Pollution sensitivity: Sensitive to ozone (Ryan 1990)

Comments: None

Deposition of specimens: BRY C-37450, BRY C-38685

Phycia adscendens (Fr.) H. Olivier

Growth form: Foliose

Substrate: Bark

Site(s): Canyon Overlook Picnic Area, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock)

Relative abundance: Rare to locally common

Pollution sensitivity: Intermediately sensitive to sulfur dioxide; sensitive to fluoride (Ryan 1990)

Comments: None

Deposition of specimens: BRY C-38420, BRY C-37468

Phycia biziana (A. Massal.) Zahlbr.

Growth form: Foliose

Substrate: Rock, lignum

Site(s): Red Rock Nature Trail, canyon east of Split Mountain Gorge

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38784, BRY C-38855

Phycia caesia (Hoffm.) F  rn  r.

Growth form: Foliose

Substrate: Rock

Site(s): Gates of Lodore, vicinity of Thanksgiving Point, Deerlodge Park, Zenobia Peak

Relative abundance: Rare to locally common

Pollution sensitivity: Intermediately sensitive to sulfur dioxide (Ryan 1990)

Comments: None

Deposition of specimens: BRY C-37366, BRY C-38452, BRY C-21608, BRY C-38689

Phycia dimidiata (Arnold) Nyl.

Growth form: Foliose

Substrate: Lignum, bark, over moss, rock

Site(s): vicinity of Thanksgiving Point, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), Deerlodge Park, Plug Hat Picnic Area

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37388c, BRY C-37473, BRY C-38476, BRY C-38608, BRY C-38609, BRY C-38610

Physcia dubia (Hoffm.) Lettau

Growth form: Foliose

Substrate: Rock, bark, lignum

Site(s): Canyon Overlook Picnic Area, vicinity of Thanksgiving Point, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), vicinity of Haystack Rock, along Jones Hole Creek, vicinity of Echo Park, mouth of Sand Canyon, Harding Hole Overlook, trail to Harper's Corner, Plug Hat Picnic Area, Zenobia Peak, Hog Canyon, Red Rock Nature Trail, canyon east of Split Mountain Gorge

Relative abundance: Rare to locally common

Pollution sensitivity: Sensitive to intermediately sensitive to fluoride (Ryan 1990)

Comments: None

Deposition of specimens: BRY C-37355, BRY C-37404, BRY C-38417, BRY C-38421, BRY C-37461, BRY C-37496, BRY C-26005, BRY C-26082, BRY C-26133, BRY C-26213, BRY C-38522, BRY C-38606, BRY C-38679, BRY C-38686, BRY C-38719, BRY C-38785, BRY C-38852, BRY C-38858

Physcia stellaris (L.) Nyl.

Growth form: Foliose

Substrate: Bark

Site(s): Canyon Overlook Picnic Area, vicinity of Thanksgiving Point, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), Plug Hat Picnic Area, Zenobia Peak, Hog Canyon

Relative abundance: Rare to locally common

Pollution sensitivity: Intermediately sensitive to sulfur dioxide (Wetmore 1987)

Comments: None

Deposition of specimens: BRY C-37385, BRY C-37403, BRY C-38418, BRY C-38419, BRY C-37464, BRY C-38607, BRY C-38682, BRY C-38721

Physciella chloantha (Ach.) Essl.

Growth form: Foliose

Substrate: Rock, bark, burned wood

Site(s): Plug Hat Picnic Area, Hog Canyon, canyon east of Split Mountain Gorge

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38605, BRY C-38720, BRY C-38854

Physciella nepalensis (Poelt) Essl.

Growth form: Foliose

Substrate: Rock

Site(s): canyon east of Split Mountain Gorge

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38853, BRY C-38873

Physconia isidiigera (Zahlbr.) Essl.

Growth form: Foliose

Substrate: Moss/soil over rock/bark

Site(s): along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock),
Plug Hat Picnic Area, Zenobia Peak

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37435, BRY C-38612, BRY C-38690

Physconia muscigena (Ach.) Poelt

Growth form: Foliose

Substrate: Moss over rock/soil, over detritus, over burned wood

Site(s): Gates of Lodore, along Jones Hole Creek, vicinity of Echo Park, Hog
Canyon, Red Rock Nature Trail, canyon east of Split Mountain Gorge

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-26068, BRY C-26073, BRY C-21791, BRY C-
38725, BRY C-38786, BRY C-38856, BRY C-38857Physconia perisidiosa (Erichsen) Moberg

Growth form: Foliose

Substrate: over Dermatocarpon sp. on rock

Site(s): Zenobia Peak

Relative abundance: Rare

Pollution sensitivity: Intermediately sensitive to sulfur dioxide (Mc Cune &
Geiser 1997)

Comments: None

Deposition of specimens: BRY C-38692

Physconia thomsonii Essl.

Growth form: Foliose

Substrate: Rock, moss over bark

Site(s): Plug Hat Picnic Area, Hog Canyon

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38611, BRY C-38724

Placidium squamulosum (Ach.) Breuss

Growth form: Squamulose

Substrate: Soil over rock, soil

Site(s): Plug Hat Picnic Area, Red Rock Nature Trail, vicinity of Thanksgiving Point, vicinity of Haystack Rock, along Jones Hole Creek, mouth of Sand Canyon, Deerlodge Park, Harding Hole Overlook, vicinity of Mantle Ranch turnoff, trail to Harper's Corner, Gates of Lodore, Hog Canyon, canyon east of Split Mountain Gorge

Relative abundance: Locally common to abundant

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37357, BRY C-37490, BRY C-26039, BRY C-26151, BRY C-38498, BRY C-26181, BRY C-26261, BRY C-38518, BRY C-21671, BRY C-38550, BRY C-38711, BRY C-38757, BRY C-38859

Placidium tuckermanii (Rav. ex Mont.) Breuss

Growth form: Squamulose

Substrate: Lignum

Site(s): vicinity of Mantle Ranch turnoff, canyon east of Split Mountain Gorge

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-26242, BRY C-38825, BRY C-38886

Pleopsidium flavum (Bellardi) Körber

Growth form: Crustose (with effigurate margins)

Substrate: Rock

Site(s): Gates of Lodore

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-21771

Polysporina simplex (Davies) Vezda

Growth form: Crustose

Substrate: Rock

Site(s): Red Rock Nature Trail, Deerlodge Park, Point of Pines

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38464, BRY C-38742, BRY C-38787

Psora cerebriiformis W.A. Weber

Growth form: Squamulose

Substrate: Soil

Site(s): Trail to Harper's Corner, Plug Hat Picnic Area, Red Rock

Nature Trail, canyon east of Split Mountain Gorge, vicinity of Thanksgiving Point, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), vicinity of Haystack Rock, along Jones Hole Creek, vicinity of Echo Park, mouth of Sand Canyon, Deerlodge Park, Harding Hole Overlook, vicinity of Mantle Ranch turnoff, Gates of Lodore

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37352, BRY C-37455, BRY C-37494, BRY C-26056, BRY C-26075, BRY C-26150, BRY C-38493, BRY C-26187, BRY C-26246, BRY C-38524, BRY C-21675, BRY C-38615, BRY C-38789, BRY C-38811, BRY C-38860

Psora decipiens (Hedwig) Hoffm.

Growth form: Squamulose

Substrate: Soil

Site(s): vicinity of Haystack Rock, along Jones Hole Creek, mouth of Sand Canyon, Deerlodge Park, Harding Hole Overlook, vicinity of Mantle Ranch turnoff, Gates of Lodore

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37483, BRY C-26060, BRY C-26152, BRY C-38492, BRY C-26184, BRY C-26262, BRY C-21673

Psora globifera (Ach.) A. Massal.

Growth form: Squamulose

Substrate: Soil

Site(s): Trail to Harper's Corner, vicinity of Thanksgiving Point, Canyon
Overlook Picnic Area

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37364, BRY C-38428, BRY C-38525

Psora himalayana (Church. Bab.) Timdal

Growth form: Squamulose

Substrate: Soil over rock

Site(s): along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock),
along Jones Hole Creek, trail to Harper's Corner, Plug Hat Picnic Area,
Zenobia Peak

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37439, BRY C-26038, BRY C-21509, BRY C-
21514, BRY C-21512, BRY C-21545a, BRY C-21545bPsora luridella (Tuck.) Fink

Growth form: Squamulose

Substrate: Soil

Site(s): Point of Pines

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38746

Psora nipponica (Zahlbr.) Gotth. Schneider

Growth Form: Squamulose

Substrate: Soil/moss over rock

Site(s): Zenobia Peak, Canyon Overlook Picnic Area

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38423, BRY C-38694

Psora tuckermanii R. Anderson ex Timdal

Growth form: Squamulose

Substrate: Soil/moss over rock, soil

Site(s): Canyon Overlook Picnic Area, Trail to Harper's Corner, Hog Canyon, canyon east of Split Mountain Gorge, Gates of Lodore, vicinity of Thanksgiving Point, vicinity of Haystack Rock, along Jones Hole Creek, vicinity of Echo Park, mouth of Sand Canyon, Deerlodge Park, Harding Hole Overlook, vicinity of Mantle Ranch turnoff, Plug Hat Picnic Area, Red Rock Nature Trail

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37343, BRY C-38422, BRY C-37481, BRY C-26045, BRY C-26074, BRY C-26158, BRY C-38490, BRY C-26182, BRY C-26264, BRY C-38523, BRY C-21672, BRY C-38552, BRY C-21536, BRY C-38614, BRY C-38727, BRY C-38788, BRY C-38861, BRY C-38862, BRY C-38863, BRY C-21510, BRY C-21513

Rhizocarpon disporum (Nägeli ex Hepp) Müll. Arg.

Growth form: Crustose

Substrate: Rock

Site(s): along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), vicinity of Mantle Ranch turnoff, Gates of Lodore

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37410, BRY C-26250, BRY C-21767

Rhizocarpon geminatum Körber

Growth form: Crustose

Substrate: Rock

Site(s): Canyon Overlook Picnic Area

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38425

Rhizocarpon geographicum (L.) DC.

Growth form: Crustose

Substrate: Rock

Site(s): Canyon Overlook Picnic Area

Relative abundance: Common

Pollution sensitivity: Sensitive to fluoride (Ryan 1990)

Comments: None

Deposition of specimens: BRY C-38426

Rhizocarpon superficiale (Schaerer) Vainio

Growth form: Crustose
 Substrate: Rock
 Site(s): Canyon Overlook Picnic Area
 Relative abundance: Rare to locally common
 Pollution sensitivity: Unknown
 Comments: None
 Deposition of specimens: BRY C-38427

Rhizoplaca chrysoleuca (Sm.) Zopf

Growth form: Foliose (umbilicate)
 Substrate: Rock
 Site(s): Zenobia Peak, Red Rock Nature Trail, Deerlodge Park, Gates of Lodore
 Relative abundance: Rare to locally common
 Pollution sensitivity: Sensitive to sulfur dioxide and NO_x/PAN (Ryan 1990)
 Comments: None
 Deposition of specimens: BRY C-38504, BRY C-38541, BRY C-38695, BRY C-38790

Rhizoplaca melanophthalma (DC.) Leuckert & Poelt

Growth form: Foliose (umbilicate)
 Substrate: Rock
 Site(s): Canyon Overlook Picnic Area, trail to Harper's Corner, Point of Pines, Red Rock Nature Trail, canyon east of Split Mountain Gorge, Gates of Lodore, vicinity of Thanksgiving Point, Deerlodge Park, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), along Jones Hole Creek, vicinity of Echo Park, mouth of Sand Canyon, Harding Hole Overlook, vicinity of Mantle Ranch turnoff, Zenobia Peak, Hog Canyon
 Relative abundance: Locally common to abundant
 Pollution sensitivity: Sensitive to sulfur dioxide and NO_x/PAN (Ryan 1990)
 Comments: None
 Deposition of specimens: BRY C-37346, BRY C-38429, BRY C-38449, BRY C-37411, BRY C-26031, BRY C-26126, BRY C-26165, BRY C-26222, BRY C-26230, BRY C-38506, BRY C-38526, BRY C-21788, BRY C-21712, BRY C-38696, BRY C-38733, BRY C-38740, BRY C-38791, BRY C-38864

Rhizoplaca peltata (Ramond) Leuckert & Poelt

Growth form: Foliose (umbilicate)

Substrate: Rock

Site(s): Trail to Harper's Corner, Point of Pines, Red Rock Nature Trail, canyon east of Split Mountain Gorge, vicinity of Thanksgiving Point, Deerlodge Park, along Jones Hole Creek, mouth of Sand Canyon, Harding Hole Overlook, vicinity of Mantle Ranch turnoff, Gates of Lodore, Plug Hat Picnic Area

Relative abundance: Locally common to abundant

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37358, BRY C-38450, BRY C-26047, BRY C-26164, BRY C-26221, BRY C-26229, BRY C-38527, BRY C-21713, BRY C-38616, BRY C-38741, BRY C-38792, BRY C-38870

Rinodina archaea (Ach.) Arnold

Growth form: Crustose

Substrate: Lignum

Site(s): Plug Hat Picnic Area

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38617

Rinodina calcigena (Th. Fr.) Lynge

Growth form: Crustose

Substrate: Rock

Site(s): Canyon Overlook Picnic Area

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38431

Sarcogyne regularis Körber

Growth form: Crustose (scant to absent)

Substrate: rock

Site(s): Deerlodge Park

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38465

Squamarina lentigera (Weber) Poelt

Growth form: Foliose

Substrate: Soil

Site(s): Plug Hat Picnic Area, Red Rock Nature Trail, Harding Hole Overlook,
vicinity of Mantle Ranch turnoff, canyon east of Split Mountain Gorge

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-26183, BRY C-26267, BRY C-38618, BRY C-
38799, BRY C-38889Staurothele areolata (Ach.) Lettau

Growth form: Crustose

Substrate: Rock

Site(s): Canyon Overlook Picnic Area, vicinity of Thanksgiving Point, along
Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), vicinity of
Haystack Rock, Deerlodge Park, Gates of Lodore, Plug Hat Picnic Area,
Zenobia Peak, Red Rock Nature Trail

Relative abundance: Locally common to abundant

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37370, BRY C-38432, BRY C-37433, BRY C-
37493, BRY C-38481, BRY C-21691, BRY C-21776, BRY C-21692, BRY
C-38619, BRY C-38698, BRY C-38794Staurothele drummondii (Tuck.) Tuck.

Growth form: Crustose

Substrate: Rock

Site(s): vicinity of Thanksgiving Point, along Mantle Ranch Road (5 miles west of
turnoff to Haystack Rock), along Jones Hole Creek, Deerlodge Park, vicinity
of Mantle Ranch turnoff

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37354, BRY C-37416, BRY C-26055, BRY C-
38466, BRY C-26231Staurothele elenkinii Oksner

Growth form: Crustose (scant)

Substrate: Rock

Site(s): vicinity of Haystack Rock

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37477

Staurothele monicae (Zahlbr.) Wetmore

Growth form: Crustose

Substrate: Rock

Site(s): Canyon Overlook Picnic Area, Deerlodge Park

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38433, BRY C-38441

Teloschistes contortuplicatus (Ach.) Clauzade & Rondon ex Vezda

Growth form: Foliose

Substrate: Rock, moss over rock

Site(s): Hog Canyon, Plug Hat Picnic Area, Point of Pines, Red Rock Nature Trail, canyon east of Split Mountain Gorge, Gates of Lodore

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-21792, BRY C-21602, BRY C-38620, BRY C-38728, BRY C-38743, BRY C-38798, BRY C-38874

Thyrea confusa Henssen

Growth form: Foliose

Substrate: Rock

Site(s): Hog Canyon, canyon east of Split Mountain Gorge, Deerlodge Park, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), mouth of Sand Canyon, Gates of Lodore

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38451, BRY C-37448, BRY C-26172, BRY C-21794, BRY C-21703, BRY C-21601, BRY C-21793, BRY C-38712d, BRY C-38875

Toninia candida (Weber) Th. Fr.

Growth form: Squamulose

Substrate: Rock

Site(s): vicinity of Echo Park

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-26116

Toninia philippea (Mont.) Timdal

Growth form: Squamulose

Substrate: Rock

Site(s): Red Rock Nature Trail

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: This taxon is a new species record for Utah.

Deposition of specimens: BRY C-38768

Toninia ruginosa (Tuck.) Herre subsp. ruginosa

Growth form: Squamulose

Substrate: Soil

Site(s): Gates of Lodore, Red Rock Nature Trail

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-21811, BRY C-21674, BRY C-21717, BRY C-38803

Toninia sedifolia (Scop.) Timdal

Growth form: Squamulose

Substrate: Soil, soft sandstone

Site(s): Plug Hat Picnic Area, Red Rock Nature Trail, Gates of Lodore, vicinity of Thanksgiving Point, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), vicinity of Haystack Rock, along Jones Hole Creek, vicinity of Echo Park, Deerlodge Park, Harding Hole Overlook, vicinity of Mantle Ranch turnoff, Hog Canyon, canyon east of Split Mountain Gorge

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37369, BRY C-37456, BRY C-37476, BRY C-26058, BRY C-26101, BRY C-38491, BRY C-26189, BRY C-26263, BRY C-38624, BRY C-38726, BRY C-38731, BRY C-38802, BRY C-38887

Toninia tristis (Th. Fr.) Th. Fr. subsp. tristis

Growth form: Squamulose

Substrate: Soil

Site(s): Red Rock Nature Trail, canyon east of Split Mountain Gorge, vicinity of Echo Park, Gates of Lodore

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-26076, BRY C-21714, BRY C-38801, BRY C-38876

Umbilicaria virginis Schaerer

Growth form: Foliose (umbilicate)

Substrate: Rock

Site(s): Zenobia Peak, Gates of Lodore

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-21708, BRY C-38699

Usnea hirta (L.) F.H. Wigg.

Growth form: Fruticose

Substrate: Lignum, bark

Site(s): Plug Hat Picnic Area, Zenobia Peak, Point of Pines

Relative abundance: Rare

Pollution sensitivity: Sensitive to intermediately sensitive
to sulfur dioxide (Wetmore 1987)

Comments: None

Deposition of specimens: BRY C-38629, BRY C-38700, BRY C-38701, BRY C-38744

Usnea subfloridana Stirton

Growth form: Fruticose

Substrate: Bark

Site(s): along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock)

Relative abundance: Rare

Pollution sensitivity: Sensitive to intermediately sensitive to sulfur dioxide
(Wetmore 1987)

Comments: None

Deposition of specimens: BRY C-37467

Verrucaria viridula (Schrader) Ach.

Growth form: Crustose

Substrate: Rock

Site(s): Plug Hat Picnic Area

Relative abundance: Rare to locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-21505

Xanthoparmelia chlorochroa (Tuck.) Hale

Growth form: Foliose (vargrant)

Substrate: Soil

Site(s): Canyon Overlook Picnic Area, Gates of Lodore

Relative abundance: Locally common to abundant

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38435, BRY C-21813

Xanthoparmelia cumberlandia (Gyelnik) Hale

Growth form: Foliose

Substrate: Rock

Site(s): vicinity of Echo Park

Relative abundance: Locally common

Pollution sensitivity: Sensitive to sulfur dioxide (Ryan 1990)

Comments: None

Deposition of specimens: BRY C-26125

Xanthoparmelia mexicana (Gyelnik) Hale

Growth form: Foliose

Substrate: Rock

Site(s): Gates of Lodore

Relative abundance: Locally common

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-21711

Xanthoparmelia plittii (Gyelnik) Hale

Growth form: Foliose

Substrate: Rock, lignum, moss over rock

Site(s): Canyon Overlook Picnic Area, Deerlodge Park, vicinity of Mantle Ranch
turnoff, Gates of Lodore, Plug Hat Picnic Area, Zenobia Peak, Red Rock
Nature Trail, canyon east of Split Mountain Gorge

Relative abundance: Locally common to abundant

Pollution sensitivity: Unknown

Comments: Lignum is an unusual substrate for this species

Deposition of specimens: BRY C-37401, BRY C-38447, BRY C-26249, BRY C-
21715, BRY C-38630, BRY C-38702, BRY C-38806, BRY C-38878

Xanthoria candelaria (L.) Th. Fr.

Growth form: Minutely foliose

Substrate: Rock, moss over rock, bark

Site(s): Zenobia Peak, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), along Jones Hole Creek

Relative abundance: Rare

Pollution sensitivity: Sensitive to ozone (Ryan 1990); intermediately sensitive to sulfur dioxide (Wetmore 1987)

Comments: None

Deposition of specimens: BRY C-37436, BRY C-26013, BRY C-38703, BRY C-38705

Xanthoria elegans (Link) Th. Fr.

Growth form: Foliose

Substrate: Rock, moss over rock, dead wood

Site(s): Zenobia Peak, Plug Hat Picnic Area, Gates of Lodore, vicinity of Thanksgiving Point, Deerlodge Park, along Jones Hole Creek, vicinity of Echo Park, mouth of Sand Canyon, Harding Hole Overlook, vicinity of Mantle Ranch turnoff, trail to Harper's Corner, Point of Pines, Red Rock Nature Trail, canyon east of Split Mountain Gorge

Relative abundance: Locally common to abundant

Pollution sensitivity: Intermediately sensitive to sulfur dioxide (Mc Cune and Geiser 1997)

Comments: Dead wood is an unusual substrate for this species

Deposition of specimens: BRY C-37351, BRY C-38455, BRY C-26015, BRY C-26132, BRY C-26157, BRY C-38473, BRY C-26218, BRY C-26232, BRY C-38530, BRY C-21773, BRY C-21597, BRY C-38631, BRY C-38704, BRY C-38745, BRY C-38807, BRY C-38880

Xanthoria fallax (Hepp) Arnold var. fallax

Growth form: Foliose

Substrate: Lignum, bark, rock

Site(s): Canyon Overlook Picnic Area, Red Rock Nature Trail, canyon east of Split Mountain Gorge, vicinity of Thanksgiving Point, along Jones Hole Creek, Plug Hat Picnic Area, Zenobia Peak

Relative abundance: Locally common to abundant

Pollution sensitivity: Sensitive to intermediately sensitive to sulfur dioxide (Ryan 1990)

Comments: Rock is an unusual substrate for this species

Deposition of specimens: BRY C-37382, BRY C-38436, BRY C-38437, BRY C-26008, BRY C-38632, BRY C-38706, BRY C-38809, BRY C-38881, BRY C-38882, BRY C-38883

Xanthoria polycarpa (Hoffm.) Rieber

Growth form: Foliose

Substrate: Bark, lignum

Site(s): Canyon Overlook Picnic Area, vicinity of Thanksgiving Point, along Mantle Ranch Road (5 miles west of turnoff to Haystack Rock), along Jones Hole Creek, vicinity of Echo Park, mouth of Sand Canyon, Plug Hat Picnic Area, Red Rock Nature Trail, canyon east of Split Mountain Gorge

Relative abundance: Locally common

Pollution sensitivity: Sensitive to intermediately sensitive to sulfur dioxide (Ryan 1990)

Comments: None

Deposition of specimens: BRY C-37383, BRY C-38438, BRY C-38439, BRY C-37463, BRY C-26009, BRY C-26122, BRY C-26160, BRY C-38633, BRY C-38808, BRY C-38879

Xanthoria sorediata (Vainio) Poelt

Growth form: Foliose

Substrate: Rock, growing over *Psora tuckermanii*

Site(s): Zenobia Peak, Canyon Overlook Picnic Area, vicinity of Thanksgiving Point, vicinity of Echo Park

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-37348, BRY C-38440, BRY C-26117, BRY C-38707

Xylographa parallela (Ach. : Fr.) Behlen and Desberger

Growth form: endoxylic

Substrate: Lignum

Site(s): canyon east of Split Mountain Gorge

Relative abundance: Rare

Pollution sensitivity: Unknown

Comments: None

Deposition of specimens: BRY C-38885

OBSERVATIONS AND CONCLUSIONS:

1. Lichens collected at 18 biomonitoring reference sites in Dinosaur National Monument comprise a diverse and well developed flora. From our collections we have identified a total of 168 species in 55 genera. All growth forms are represented; however the flora is dominated by crustose species (51%, 85 species), followed by foliose lichens (32%, 54 species). Squamulose lichens make up 13% of the flora (22 species), while fruticose taxa comprise 4% of the flora with 7 species. This growth form pattern is somewhat similar to other lichen floras in the region (e.g., the High Uintas Wilderness Area in northeastern Utah had 50% crustose and 29% foliose, while the Bridger Wilderness Area in western Wyoming had 48% crustose and 28% foliose). A similar study conducted at several sites along the

Wasatch Front yielded an even higher percentage of crustose species (60.3%, 91 out of 155 total species). The abundance of crustose lichens in Dinosaur National Monument is most likely due to the arid conditions typical of the region.

2. Lichen specimens were collected from 5 basic substrates: rocks, lignum/bark, soil, other lichens, and moss/detritus. A total of 85 species (50% of the flora) were collected from rock substrates. Soil lichens were next in abundance, with a total 38 species or 23% of the flora. Thirty-five species (21% of the flora) were collected from bark/lignum substrates, with 8 species on moss/detritus (5%), and 2 species on other lichens (1%). Intermountain Area lichen floras are typically dominated by saxicolous (rock) lichens. For example, the Bridger Wilderness Area, in western Wyoming, shows a similar pattern with 51% (76 species) reported from rock substrates and 23% (35 species) from bark and lignum.
3. Total species diversity (168 species in 55 genera) suggests that lichen communities in Dinosaur National Monument are well developed and diverse (the total number of genera and species will likely increase somewhat as we confirm identification of several difficult groups with experts). The average number of sensitive indicator species per reference site (7.2, range: 3-19) is fairly typical for the region. For example, the Wasatch Front had 6.3 species/reference site, while the Bridger Wilderness Area, in western Wyoming, had 8.0; and the High Uintas Wilderness Area in northeastern Utah had 10.3.
4. Necrotic and/or bleached thalli (typical signs of air pollution-related impact) were not observed in either the field or herbarium.
5. Baseline concentrations of 21 potential pollutant elements were determined by analyzing the tissues of at least one sensitive indicator species from each reference site (Table 1). Generally, pollutant element concentrations in lichen samples from Dinosaur National Monument were at or below background levels. Copper-zinc and iron-titanium ratios were also well within background levels (< 0.5 and <9.0 respectively) ranging between .06 and .26 and 4.1 and 7.35 respectively. These patterns suggest no evidence for either copper or iron pollution in the monument. However, two elements, arsenic and chromium exceeded background levels (Figure 2) in all 26 sensitive indicator species samples. Arsenic concentrations ranged from 1.4 to 7.9 ppm with chromium concentrations ranging between 2.9 and 27 ppm. This combination of elevated heavy metals suggests the possibility of a local air pollution source, perhaps the nearby coal-fired power plant.

Lichenologists agree that thallus sulfur concentrations of .2% or higher indicate significant sulfur accumulation, which may interfere with sensitive metabolic activities such as photosynthesis, cellular respiration and nitrogen fixation. Sulfur concentrations in lichen tissues from Dinosaur National Monument are generally well below the .2% level. However, four samples one each from the following reference sites: Canyon Overlook (.24%), Harper's Corner (.22%), Plug Hat Picnic Area (.20%), and along Mantle Ranch Road (.21%) did show elevated sulfur concentrations. All four of these samples are bark specimens of the foliose lichen *Xanthoria polycarpa*. The fact that most of the samples 22/26 were well below the .2% level suggests the need for a wait and watch approach to the sulfur question. Likewise, the elevated As and Cr levels also demands watching.

TABLE #1: Mean concentrations of potential pollutant elements in sensitive indicator species from air quality biomonitoring reference sites in the Dinosaur National Monument.

| Species and Collection Site | Elements (ppm except where indicated) | | | | | | | | | |
|--|---------------------------------------|------|------|------|------|------|------|-----|-----|----|
| | S% | Cl | K% | Ca% | Ti | V | Cr | Ni | Cu | Zn |
| <i>Rhizoplaca peltata</i> , Split Mtn. Gorge, Sample #25, on rock | 0.084 | 2300 | 0.29 | 5.7 | 450 | 16.1 | 5.3 | 2.4 | 6.2 | 30 |
| <i>Rhizoplaca peltata</i> , Plug Hat Picnic Area, Sample #27, on rock | 0.056 | 1440 | 0.35 | 9.2 | 680 | 19.2 | 5.3 | 5.5 | 7.2 | 31 |
| <i>Rhizoplaca</i> sp., Deerlodge Park, Sample #145, on rock | 0.101 | 1480 | 0.25 | 3.2 | 280 | 8.9 | 4 | 2.1 | 5.4 | 27 |
| <i>Rhizoplaca melanophthalma</i> , Gates of Lodore, Sample #183, on rock | 0.1 | 1700 | 0.33 | 6.3 | 590 | 15.3 | 7.4 | 4.4 | 7.1 | 31 |
| <i>Rhizoplaca melanophthalma</i> , Harding's Hole Overlook, Sample #302, on rock | 0.066 | 1510 | 0.38 | 11 | 760 | 22 | 12.1 | 6.9 | 5.8 | 21 |
| <i>Rhizoplaca peltata</i> , Sand Canyon, Sample #303, on rock | 0.086 | 2300 | 0.27 | 4.9 | 510 | 12.4 | 5.4 | 4.1 | 5.8 | 26 |
| <i>Rhizoplaca melanophthalma</i> , Tampa Bench Rd., Sample #304, on rock | 0.079 | 1510 | 0.34 | 9.4 | 450 | 14.9 | 7.7 | 4.4 | 6.3 | 23 |
| <i>Xanthoparmelia</i> sp., Tampa Bench Rd., Sample #305, on rock | 0.052 | 159 | 0.46 | 6.7 | 1030 | 20 | 7.9 | 4.8 | 8.4 | 38 |
| <i>Rhizoplaca peltata</i> , Jones Hole Trail, Sample #306, on rock | 0.061 | 1950 | 0.23 | 6.7 | 290 | 12.7 | 4.2 | 2.1 | 4.3 | 25 |
| <i>Rhizoplaca melanophthalma</i> , Jones Hole Trail, Sample #307, on rock | 0.067 | 1310 | 0.23 | 7.6 | 280 | 10.9 | 4.4 | 2.8 | 3.9 | 32 |
| <i>Xanthoparmelia cumberlandia</i> , Echo Park, Sample #308, on rock | 0.121 | 1570 | 0.45 | 1.92 | 460 | 15.7 | 15.3 | 4.2 | 6.6 | 26 |
| <i>Rhizoplaca melanophthalma</i> , Echo Park, Sample #309, on rock | 0.081 | 88 | 0.3 | 3 | 280 | 12 | 8.2 | 4.8 | 5.3 | 22 |

TABLE #1 continued: Mean concentrations of potential pollutant elements in sensitive indicator species from air quality biomonitoring reference sites in the Dinosaur National Monument.

| Species and Collection Site | Elements (ppm except where indicated) | | | | | | | | | |
|--|---------------------------------------|----|------|------|-----|-----|------|------|-----|------|
| | Pb | Mn | Fe | Co | As | Se | Br | Rb | Sr | Al |
| <i>Rhizoplaca peltata</i> , Split Mtn. Gorge, Sample #25, on rock | 43 | 36 | 2600 | 14.1 | 3 | 2.1 | 13 | 7.1 | 71 | 3600 |
| <i>Rhizoplaca peltata</i> , Plug Hat Picnic Area, Sample #27, on rock | 17.8 | 85 | 3800 | 18.8 | 3.6 | 2.2 | 12.7 | 17.6 | 72 | 5200 |
| <i>Rhizoplaca sp.</i> , Deerlodge Park, Sample #145, on rock | 20 | 27 | 1880 | 15.8 | 2.3 | 1.8 | 13.3 | 12.4 | 53 | 3000 |
| <i>Rhizoplaca melanophthalma</i> , Gates of Lodore, Sample #183, on rock | 22 | 48 | 3700 | 19 | 3.6 | 2.2 | 9.8 | 6.9 | 95 | 4500 |
| <i>Rhizoplaca melanophthalma</i> , Harding's Hole Overlook, Sample #302, on rock | 23 | 53 | 4400 | 25 | 7 | 3.6 | 14.2 | 13.9 | 191 | 6500 |
| <i>Rhizoplaca peltata</i> , Sand Canyon, Sample #303, on rock | 30 | 40 | 2900 | 15.8 | 2.7 | 2.4 | 14.1 | 8.2 | 104 | 3900 |
| <i>Rhizoplaca melanophthalma</i> , Tampa Bench Rd., Sample #304, on rock | 16.6 | 42 | 2700 | 14.4 | 2.8 | 2.3 | 17.1 | 10.9 | 120 | 3900 |
| <i>Xanthoparmelia sp.</i> , Tampa Bench Rd., Sample #305, on rock | 29 | 62 | 5600 | 26 | 4.6 | 2.8 | 19.3 | 21 | 160 | 6600 |
| <i>Rhizoplaca peltata</i> , Jones Hole Trail, Sample #306, on rock | 16.9 | 32 | 1790 | 11.1 | 3.6 | 3.8 | 14.5 | 7.2 | 78 | 1850 |
| <i>Rhizoplaca melanophthalma</i> , Jones Hole Trail, Sample #307, on rock | 18.6 | 38 | 1770 | 10.8 | 3.9 | 3.1 | 15.9 | 7.8 | 150 | 1990 |
| <i>Xanthoparmelia cumberlandia</i> , Echo Park, Sample #308, on rock | 20 | 85 | 3000 | 15.3 | 3.6 | 2.5 | 22 | 13.6 | 54 | 4400 |
| <i>Rhizoplaca melanophthalma</i> , Echo Park, Sample #309, on rock | 18.7 | 38 | 1820 | 8.9 | 3.2 | 1.9 | 1.6 | 8.3 | 62 | 2200 |

TABLE #1 continued: Mean concentrations of potential pollutant elements in sensitive indicator species from air quality biomonitoring reference sites in the Dinosaur National Monument.

| Species and Collection Site | Elements (ppm except where indicated) | | |
|--|---------------------------------------|------|-----|
| | Si | P | Ba |
| <i>Rhizoplaca peltata</i> , Split Mtn. Gorge, Sample #25, on rock | 20000 | 910 | 77 |
| <i>Rhizoplaca peltata</i> , Plug Hat Picnic Area, Sample #27, on rock | 36000 | 850 | 86 |
| <i>Rhizoplaca sp.</i> , Deerlodge Park, Sample #145, on rock | 16800 | 1080 | 63 |
| <i>Rhizoplaca melanophthalma</i> , Gates of Lodore, Sample #183, on rock | 24000 | 1090 | 104 |
| <i>Rhizoplaca melanophthalma</i> , Harding's Hole Overlook, Sample #302, on rock | 33000 | 1200 | 112 |
| <i>Rhizoplaca peltata</i> , Sand Canyon, Sample #303, on rock | 17700 | 900 | 75 |
| <i>Rhizoplaca melanophthalma</i> , Tampa Bench Rd., Sample #304, on rock | 20000 | 1040 | 74 |
| <i>Xanthoparmelia sp.</i> , Tampa Bench Rd., Sample #305, on rock | 32000 | 870 | 119 |
| <i>Rhizoplaca peltata</i> , Jones Hole Trail, Sample #306, on rock | 9400 | 880 | 69 |
| <i>Rhizoplaca melanophthalma</i> , Jones Hole Trail, Sample #307, on rock | 13800 | 890 | 81 |
| <i>Xanthoparmelia cumberlandia</i> , Echo Park, Sample #308, on rock | 35000 | 1370 | 112 |
| <i>Rhizoplaca melanophthalma</i> , Echo Park, Sample #309, on rock | 19600 | 1060 | 68 |

TABLE #1: Mean concentrations of potential pollutant elements in sensitive indicator species from air quality biomonitoring reference sites in the Dinosaur National Monument.

| Species and Collection Site | Elements (ppm except where indicated) | | | | | | | | | |
|--|---------------------------------------|------|------|------|------|------|------|-----|------|------|
| | S% | Cl | K% | Ca% | Ti | V | Cr | Ni | Cu | Zn |
| <i>Lecanora muralis</i> , Echo Park, Sample #310, on rock | 0.038 | 990 | 0.47 | 15.8 | 1880 | 48 | 10.8 | 6.7 | 6.3 | 30 |
| <i>Rhizoplaca peltata</i> , Desert Voices Nature Trail, Sample #764, on rock | 0.046 | 390 | 0.33 | 6.8 | 920 | 20 | 8 | 6.5 | 5.8 | 23 |
| <i>Xanthoria polycarpa</i> , Desert Voices Nature Trail, Sample #765, on bark | 0.15 | 330 | 0.5 | 0.54 | 1150 | 17.1 | 11 | 7.6 | 12 | 117 |
| <i>Xanthoria polycarpa</i> , Canyon Overlook, Sample #766, on bark | 0.24 | 1120 | 0.9 | 0.38 | 520 | 11 | 10.7 | 4.3 | 8.4 | 85 |
| <i>Rhizoplaca melanophthalma</i> , Canyon Overlook, Sample #767, on rock | 0.095 | 161 | 0.28 | 3.2 | 197 | 8.3 | 4.1 | 3.4 | 7.2 | 45 |
| <i>Rhizoplaca melanophthalma</i> , Harpers Corner, Sample #768, on rock | 0.062 | 71 | 0.25 | 5.9 | 370 | 10.7 | 2.9 | 2.1 | 4.9 | 24 |
| <i>Xanthoria polycarpa</i> , Harpers Corner, Sample #769, on bark | 0.22 | 850 | 0.86 | 0.49 | 1090 | 29 | 13.6 | 5.8 | 17.5 | 108 |
| <i>R. melanophthalma</i> & <i>peltata</i> , Plug Hat Picnic Area, Sample #770, on rock | 0.046 | 240 | 0.21 | 7.6 | 260 | 9.9 | 9.1 | 4.8 | 2.8 | 20 |
| <i>Xanthoria polycarpa</i> , Plug Hat Picnic Area, Sample #771, on bark | 0.2 | 820 | 1.05 | 0.35 | 1040 | 22 | 12.3 | 7.3 | 11.8 | 184 |
| <i>Xanthoria polycarpa</i> , Mantle Ranch Road, Sample #772, on sagebrush | 0.142 | 500 | 0.8 | 0.44 | 1290 | 22 | 27 | 6.7 | 10.4 | 120 |
| <i>Rhizoplaca melanophthalma</i> , Mantle Ranch Road, Sample #773, on rock | 0.064 | 136 | 0.24 | 4.4 | 430 | 10.3 | 6.7 | 3.9 | 4.1 | 18.7 |
| <i>Xanthoria polycarpa</i> , Mantle Ranch Road, Sample #774, on bark | 0.21 | 880 | 0.89 | 0.73 | 550 | 12.7 | 7.3 | 3.3 | 9.7 | 112 |

TABLE #1 continued: Mean concentrations of potential pollutant elements in sensitive indicator species from air quality biomonitoring reference sites in the Dinosaur National Monument.

| Species and Collection Site | Elements (ppm except where indicated) | | | | | | | | | |
|--|---------------------------------------|-----|------|------|-----|-----|------|------|-----|-------|
| | Pb | Mn | Fe | Co | As | Se | Br | Rb | Sr | Al |
| <i>Lecanora muralis</i> , Echo Park, Sample #310, on rock | 24 | 70 | 7900 | 36 | 6.7 | 3.5 | 7.6 | 23 | 189 | 15500 |
| <i>Rhizoplaca peltata</i> , Desert Voices Nature Trail, Sample #764, on rock | 16.8 | 96 | 5000 | 28 | 2.4 | 2.3 | 3.8 | 14.9 | 260 | 5000 |
| <i>Xanthoria polycarpa</i> , Desert Voices Nature Trail, Sample #765, on bark | 16.5 | 57 | 5400 | 20 | 6.4 | 1.9 | 4.5 | 18 | 79 | 8500 |
| <i>Xanthoria polycarpa</i> , Canyon Overlook, Sample #766, on bark | 11 | 71 | 3200 | 13.4 | 1.9 | 2.2 | 12.1 | 14 | 33 | 4800 |
| <i>Rhizoplaca melanophthalma</i> , Canyon Overlook, Sample #767, on rock | 7.1 | 25 | 1150 | 6.2 | 1.4 | 1.7 | 1.7 | 6.2 | 47 | 1280 |
| <i>Rhizoplaca melanophthalma</i> , Harpers Corner, Sample #768, on rock | 13.3 | 29 | 2200 | 10.3 | 4.1 | 2.3 | 2.5 | 7.2 | 44 | 3000 |
| <i>Xanthoria polycarpa</i> , Harpers Corner, Sample #769, on bark | 16.6 | 90 | 7000 | 29 | 7.9 | 1.9 | 16.7 | 27 | 51 | 8900 |
| <i>R. melanophthalma</i> & <i>peltata</i> , Plug Hat Picnic Area, Sample #770, on rock | 10.2 | 37 | 1910 | 12.5 | 2.7 | 2.6 | 2.4 | 9.3 | 58 | 2400 |
| <i>Xanthoria polycarpa</i> , Plug Hat Picnic Area, Sample #771, on bark | 7.4 | 113 | 5500 | 24 | 6 | 2.3 | 7.9 | 28 | 36 | 11500 |
| <i>Xanthoria polycarpa</i> , Mantle Ranch Road, Sample #772, on bark | 10.3 | 90 | 6600 | 33 | 5.3 | 2.5 | 11.4 | 27 | 43 | 12200 |
| <i>Rhizoplaca melanophthalma</i> , Mantle Ranch Road, Sample #773, on rock | 13.7 | 25 | 2600 | 15.4 | 1.9 | 1.8 | 0.8 | 9.1 | 48 | 3400 |
| <i>Xanthoria polycarpa</i> , Mantle Ranch Road, Sample #774, on bark | 14.5 | 72 | 3400 | 13.9 | 3.3 | 2 | 9.6 | 12.3 | 39 | 5200 |

TABLE #1 continued: Mean concentrations of potential pollutant elements in sensitive indicator species from air quality biomonitoring reference sites in the Dinosaur National Monument.

| Species and Collection Site | Elements (ppm except where indicated) | | |
|--|---------------------------------------|------|-----|
| | Si | P | Ba |
| <i>Lecanora muralis</i> , Echo Park, Sample #310, on rock | 72000 | 970 | 240 |
| <i>Rhizoplaca peltata</i> , Desert Voices Nature Trail, Sample #764, on rock | 24000 | 690 | 102 |
| <i>Xanthoria polycarpa</i> , Desert Voices Nature Trail, Sample #765, on bark | 32000 | 1050 | 120 |
| <i>Xanthoria polycarpa</i> , Canyon Overlook, Sample #766, on bark | 21000 | 1640 | 74 |
| <i>Rhizoplaca melanophthalma</i> , Canyon Overlook, Sample #767, on rock | 8600 | 870 | 51 |
| <i>Rhizoplaca melanophthalma</i> , Harpers Corner, Sample #768, on rock | 15400 | 900 | 68 |
| <i>Xanthoria polycarpa</i> , Harpers Corner, Sample #769, on bark | 35000 | 1360 | 161 |
| <i>R. melanophthalma</i> & <i>peltata</i> , Plug Hat Picnic Area, Sample #770, on rock | 16900 | 750 | 63 |
| <i>Xanthoria polycarpa</i> , Plug Hat Picnic Area, Sample #771, on bark | 61000 | 2400 | 138 |
| <i>Xanthoria polycarpa</i> , Mantle Ranch Road, Sample #772, on bark | 59000 | 1340 | 125 |
| <i>Rhizoplaca melanophthalma</i> , Mantle Ranch Road, Sample #773, on rock | 12000 | 770 | 63 |
| <i>Xanthoria polycarpa</i> , Mantle Ranch Road, Sample #774, on bark | 17800 | 2300 | 117 |

TABLE #1: Mean concentrations of potential pollutant elements in sensitive indicator species from air quality biomonitoring reference sites in the Dinosaur National Monument.

| Species and Collection Site | Elements (ppm except where indicated) | | | | | | | | | |
|--|---------------------------------------|-----|------|-----|-----|------|------|-----|-----|----|
| | S% | Cl | K% | Ca% | Ti | V | Cr | Ni | Cu | Zn |
| <i>Rhizoplaca peltata</i> , Mantle Ranch Road, Sample #775, on rock | 0.047 | 450 | 0.2 | 4.4 | 360 | 9.5 | 4.2 | 2.7 | 5.5 | 21 |
| <i>Xanthoria polycarpa</i> , Mantle Ranch Road, Sample #776, on bark | 0.143 | 290 | 0.69 | 2.6 | 830 | 17.8 | 14.8 | 7.1 | 8.8 | 53 |

TABLE #1 continued: Mean concentrations of potential pollutant elements in sensitive indicator species from air quality biomonitoring reference sites in the Dinosaur National Monument.

| Species and Collection Site | Elements (ppm except where indicated) | | | | | | | | | |
|--|---------------------------------------|----|------|------|-----|-----|-----|-----|----|------|
| | Pb | Mn | Fe | Co | As | Se | Br | Rb | Sr | Al |
| <i>Rhizoplaca peltata</i> , Mantle Ranch Road, Sample #775, on rock | 12.8 | 23 | 1960 | 11.8 | 2.2 | 1.8 | 1.5 | 8.4 | 44 | 1860 |
| <i>Xanthoria polycarpa</i> , Mantle Ranch Road, Sample #776, on bark | 13.2 | 76 | 3400 | 17.7 | 2.3 | 1.9 | 21 | 23 | 56 | 7800 |

TABLE #1 continued: Mean concentrations of potential pollutant elements in sensitive indicator species from air quality biomonitoring reference sites in the Dinosaur National Monument.

| Species and Collection Site | Elements (ppm except where indicated) | | | |
|--|---------------------------------------|-----|-----|--|
| | Si | P | Ba | |
| <i>Rhizoplaca peltata</i> , Mantle Ranch Road, Sample #775, on rock | 8700 | 860 | 60 | |
| <i>Xanthoria polycarpa</i> , Mantle Ranch Road, Sample #776, on bark | 40000 | 860 | 126 | |

RECOMMENDATIONS:

1. In clean air areas, review of pollutant element concentrations in sensitive indicator species should be performed every 6-8 years. In light of the elevated As and Cr levels observed in sensitive indicator species from Dinosaur National Monument we recommend that pollutant concentrations in at least one sensitive indicator species from each reference site be reevaluated every 4-5 years. Development of other significant point sources of air pollution in the area may require more frequent reevaluation.
2. Reevaluation of the lichen flora at existing reference sites is generally unnecessary, unless over time sensitive indicator species begin to show either increasing levels of pollutant elements or significant changes in relative abundance. At this point reevaluation of the lichen communities at the reference sites in Dinosaur National Monument does not appear to be necessary.

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