

Lichens of the Granite Mountains, Sweeney Granite Mountain Desert Research Center, Southwestern Mojave Desert, San Bernardino County, California

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Abstract. 75 species representing 40 genera of lichens, lichenicolous and a lignicolous fungus are reported from the Granite Mountains in the southwestern Mojave Desert. *Acarospora arenaria* H. Magn. is reported new for California.

INTRODUCTION

The Granite Mountains and its alluvial fans are in the Mojave Desert in eastern San Bernardino County, in the southwest corner of the Mojave National Preserve. They range in height from the summit of Granite Mountain (2100 meters, 6800 feet) to the open desert near the Kelso Dunes (700 meters, 2200 feet) with a total area of 22000 ha (85 sq. miles). Average temperatures range from a July maximum of 33° C (92° F) to a December minimum of -1° C (30° F). Snow fall is common in the winter months. Average annual precipitation is 22 cm (8.9"). The study area was confined to the Sweeney Granite Mountain Desert Research Center which is part of the University of California Reserve system (<http://nrs.ucop.edu/Sweeney-Granite.htm>) which encompasses the highest part of the Granite Mountains and its canyons and alluvial fans and has a total area of 3626 ha (14 sq. miles).

An excellent vascular flora of the Granite Mountains was recently published by J.M. André (2006) reporting 499 taxa from the range with only 8% of the flora consisting of exotics. Pinyon pine (*Pinus monophylla* Torrey & Fremont) and Utah Juniper (*Juniperus osteosperma* Carrier) are common at higher elevations and were the only phorophytes for a rather depauperate corticolous lichen flora. The lower canyon supported a diverse and spectacular

flora with 12 species of cacti and two species of *Yucca*. A number of common western North American annuals and perennials are well-represented including *Astragalus* (10 taxa), *Camissonia* (10 taxa), *Eriogonum* (19 taxa), *Gilia* (12 taxa) and *Phacelia* (13 taxa).

METHOD

Collecting was subjective and qualitative, included all lichen habitats in the area, and over thirty hours were spent exploring the mountains and canyons. Specimens were determined using the *Lichen Flora of the Greater Sonoran Region* [Nash et. al 2002, 2004, and 2007 (2008)] and herbarium specimens. Thin-layer chromatography (TLC) was performed on a small number of specimens by James C. Lendemer (NY), including all *Lecanora* and *Lecidea* specimens. Because of discrepancies between our species lists and the species list of an earlier foray by the California Lichen Society (Doell et. al. 1999) specimens of some collections from that foray were supplied by Shirley Tucker from the herbarium of the Santa Barbara Botanical Gardens (SBBG) and a few of these specimens have been included in our checklist for completeness. Most specimens of lichenicolous fungi were examined by Javier Etayo and Jana Kocourková (PRM) but only 6 taxa were identifiable to currently described species (Etayo et al. 2007). The other specimens have been

reserved for separate study. The checklist is arranged alphabetically by genus then species. Authorities and taxonomy generally follow Esslinger (2007) and Nash et al. [2002, 2004, 2007 (2008)]. The collection numbers following each entry are those of the author unless otherwise indicated. All specimens are deposited in the herbarium of the University of California, Riverside (UCR) unless otherwise indicated. Specific location data for specimens can be accessed on the UCR Lichen database at http://sanders5.ucr.edu/lichensflat_index.php or through the ASU lichen collections search engine at <http://seinet.asu.edu/seinet/collections/selection.jsp>. All saxicolous species were collected from granite unless otherwise stated.

TAXONOMIC CHECKLIST

- Acarospora arenacea* H. Magn. —8055. This is actually a lichenicolous fungus, occurring on an unknown host. This is a new report for California. The species will be revised in a paper on lichenicolous *Polysporina* by Knudsen & Kocourková (*in prep.*)
- Acarospora badiofusca* (Nyl.) Th. Fr.— 4439, 7977, 7999. Common on slopes.
- Acarospora bullata* Anzi —9403.1 (S). Rare.
- Acarospora macrospora* (Hepp.) Bagl.— 8017. Rare on decomposing granite in wash (Knudsen 2007).
- Acarospora nevadensis* H. Magn.— 4386. Rare. Specimen epruinose. If pruinose, the species is similar looking to *A. strigata* but KC+pink cortex from presence of gyrophoric acid (see Knudsen 2007).
- Acarospora obpallens* (Nyl. ex Hasse) Zahlbr. — 4404. Infrequent.
- Acarospora obnubila* H. Magn. — 8013, 8003. Common.
- Acarospora socialis* H. Magn. — 4461, 8024, 9392 (S, PRM, CANB). Common.
- Acarospora strigata* (Nyl.) Jatta — 4446, 4476. Infrequent.
- Aspicilia cuprea* Owe-Larss. & A. Nordin — 7986. Det. by Bjorn Owe-Larsson (UPS). Common in washes. Rich in norstictic acid.
- Aspicilia desertorum* (Kremp.) Mereschk. — 4430, 4448.1, 8011. Common.
- Buellia chloroleuca* Körb. — 4396. Rare on Juniper wood and bark, 1520 m. C- and UV- with low xanthone concentrations.
- Buellia dispersa* A. Massal. — 4417, 7991.2. Common.
- Buellia punctata* (Hoffm.) A Massal. — 4392, 8048.2. Common on decorticated conifer wood above 1500 m.
- Buellia sequax* (Nyl.) Zahlbr. — 4472, 8025. Frequent.
- Buellia venusta* (Körb) Lettau — 4431.2, 4458, Tucker 36264B (SBBG). Common.
- Caloplaca cerina* (Ehrh. ex Hedwig) Th. Fr.— 4402. Rare on decorticated juniper wood at 1588 m.
- Caloplaca crenulatella* (Nyl.) Oliv. — 4419, 7984. Common.
- Caloplaca durietzii* Magn. — 4393, 4394. Common on juniper wood and bark above 1500 m.
- Caloplaca nashii* Nav.-Ros., Gaya & Hladun — 4429.2, 4389, 8006. Common.
- Caloplaca citrina* (Hoffm.) Th. Fr. — 8047. Rare.
- Candelariella aurella* (Hoffm.) Zahlbr. — 4390. Common.
- Cercidospora caudata* Kernst. — Tucker 36277 on unknown *Caloplaca* thallus at Cove Springs, (SBBG)(Etayo et. al. 2007). The species is common on *Caloplaca squamosa* and *C. subsoluta* and is treated here as *C. caudata* s. lato. (Navarro Rosines et. al. 2004.) but at least some of the specimens collected in southern California need further study because the ascospores are more radically heteropolar than *C. caudata* sensu stricto and more similar to the ascospores of *C. epicarphinea* (Nyl.) Grube & Hafellner.
- Cercidospora macrospora* (Uloth) Hafellner & Nav.-Ros. 9399 (NY) 9410 (PRM). Frequent on thallus of *Lecanora muralis*.
- Collema coccophorum* Tuck. — 8056. Common on soil.
- Collema crispum* (L.) Weber ex F.H. Wigg.— —8033, on decaying granite; Tucker 36225 & 36226B (Det. by Matthais Schultz, SBBG). Infrequent on soil, often with *C. coccophorum*.
- Dermatocarpon americanum* Vain. — 4431.1, 8028.2. Common.
- Dimelaena thysanota* (Tuck.) Hale & W.L. Culb. — 4406, 7981. Common at higher elevations.
- Lecanora argopholis* (Ach.) Ach. — 4414. Frequent at higher elevations. Det. by James C. Lendemer.
- Lecanora garovaglii* (Koerb.) Zahlbr. — 7990, 8050. Common but rarely fully developed in mixed saxicolous communities.

- Lecanora muralis* (Schreb.) Rabenh. – 4448.2. Common.
- Lecanora saligna* (Schrad.) Zahlbr. – 4409. Common on decorticated juniper wood above 1500 m.
- Lecidea hassei* Zahlbr. – 7980. Rare. This species contains schizopeltic acid and is almost impossible to determine by morphology in some populations because of pigmentation variations in the exciple of *Lecidea laboriosa* in southern California. Det. By J. C. Lendemer.
- Lecidea laboriosa* Mull. Arg. – 4407, 4429.1, 8044. Common.
- Lecidea tessellata* Florke – 4424, 4382. Common at higher elevations.
- Lecidella stigmathea* (Ach.) Hertel & Leuck. – 4432. Common.
- Lichenochora verrucicola* (Wedd.) Nik. Hoffm. & Halfellner – 9401 (PRM). Infrequent on *Aspicilia desertorum*.
- Lichenostigma subradians* Hafellner, Calat. & Nav.-Ros. – 9397 (PRM, NY), 9403.2. Common on *Acarospora socialis* and collected on *A. bullata*.
- Lichinella stipatula* Nyl. – Tucker 36265 (Det. by M. Schultz, 2003, SBBG). Frequent.
- Lichinella nigritella* (Lett.) Moreno & Egea – 4430.2, 4435, 4437. Common in shaded wash.
- Lobothallia alphoplaca* (Wahlenb. ex Ach.) Hafellner – 4440.2, 4483. Common.
- Lobothallia praeradiosa* (Nyl.) Hafellner – 4444. Infrequent.
- Melanohalea elegantula* (Zahl.) O. Blanco et al. – 4412, 4449, 4480. Common.
- Miriquidica scotopholis* (Tuck.) B.D. Ryan & Timdal – 7991.1. Infrequent.
- Muellerella pygmaea* (Körb.) D. Hawksw. var. *pygmaea* (PRM). Rare on *Acarospora* species
- Mycocalicium subtile* (Persoon) Szatala – 4410. Rare on decorticated juniper wood at 1588 m.
- Peltigera rufescens* (Weiss) Humb. – Bratt 11296 (SBBG) Rare on moss.
- Peltula euploca* (Ach.) Poelt. – 4467, 7993. Common in drainages and washes.
- Phaeophyscia sciastra* (Ach.) Moberg – 4427, 7994. Common.
- Physcia dimidiata* (Arnold) Nyl. – 8049. Common, lobes mostly narrow.
- Physcia dubia* (Hoffm.) Lettau–4436. Frequent in washes on north slopes
- Physconia isidiigera* (Zahlbr. ex Herre) Essl. – 4395, 8048.1. Infrequent on decorticated juniper wood and rock above 1558 m.
- Placidium acarosporoides* (Zahlbr.) Breuss – 4445. Common.
- Placidium lacinulatum* (Ach.) Breuss – 4453, 7997, 4450. Common on soil.
- Placidium squamulosum* (Ach.) Bruess – 4440.1. Common on soil.
- Polysporina lapponica* (Ach. ex Schaer.) Degel.– 4388, 4428, 7982, 9405, 9409 (PRM, S), 9412(PRM); Tucker 36264A (SBBG). Common on crustose lichens.
- Psora tuckermanii* Timdal – 8005. Common on decaying granite in wash
- Rhizocarpon disporum* (Naegli ex Hepp) Mull. Arg. – 4423, 7987, Common.
- Rhizoplaca peltata* (Ramond) Leukert & Poelt – 7988. Common.
- Rinodina juniperina* Sheard – 4391.1, 4397, 4425. Common on juniper bark above 1500 m. Verified by Sheard.
- Sarcogyne* species #1– 4426.1, 7976, 8054. Common taxon throughout area, currently under study by the author. This is one of several probably undescribed North American taxa.
- Sarcogyne privigna* (Ach.) A. Massal. – 4434, 4471, 8028, 9391 (PRM, S), 9407 (S). Common.
- Staurothele monicae* (Zahlbr.) Wetmore – 8009. Common.
- Stigmatidium tabacinae* (Arnold) Triebel – 4479. 1. Det. by Javier Etayo. On *Toninia tristis*. (Etayo et al. 2007). (UCR, hb. Etayo).
- Toninia ruginosa* (Tuck.) Herre ssp. *ruginosa* Timdal – 4441, 8016, 8022. Common on crumbling granite and soil in shaded washes.
- Toninia tristis* (Th. Fr.) Th. Fr.–4479.2 Rare on soil. Det. by Javier Etayo Not enough material to determine to subspecies.
- Toninia sedifolia* (Scop.) Timdal – 8032. Frequent in washes on decaying granite.
- Umbilicaria phaea* Tuck. – 9411. Frequent.
- Verrucaria fuscoatroides* Servit – 4477. Rare. Second collection from Mojave Desert (Knudsen & La Doux 2006).
- Verrucaria bernardinensis* Breuss – 7983, 8021. Frequent. Parasitic on *Staurothele monicae* becoming independent.
- Verrucaria compacta* (A. Massal.) Jatta – 8001; Tucker 36218A (SBBG). Common.

- Xanthomendoza fallax* (Hepp. ex Arnold) Sochting, Karnefelt & S. Kondr. – frequent on *Juniperus* bark, 4391.2; on decomposing granite, Tucker 36269 (SBBG) both determined by Louise Lindblom.
- Xanthoparmelia mexicana* (Gyelnik) Hale – 4416, 4456, 7978. Common.
- Xanthoparmelia novomexicana* (Gyelnik) Hale – Tucker 36267B. Det. by Nash. Rare.
- Xanthoria elegans* (Link) Th. Fr. – 4398, 4473, 8053; Tucker 36247 (SBBG) Common at higher elevations, often poorly developed, esp. at lower elevations.

CONCLUSIONS

The lichens of the Mojave Desert are spread thin and the diversity is low compared to lichen communities in other areas of Southern California. Most lichens are restricted to washes and north slopes or occur at higher elevations above 1300 meters. Many species are rare and another thirty hours of collecting, particularly at higher elevations and in washes, will probably discover another 10-20 species that are rare in the study area. We collected 75 species in 40 genera of lichens and lichenicolous fungi and a lignicolous fungus *Mycocalicium subtile*. Collecting can be quite frustrating: we could not find fertile specimens of the one or two *Heppia* species that occurred on soil. The saxicolous genus of microfungi *Lichenothelia* was represented by at least three taxa, all unfortunately rare, and more specimens are needed for identification.

Many species we found in the Granite Mountains are common in the southwestern Mojave Desert like *Acarospora socialis*, *Aspicilia desertorum*, *Lobothallia alphoplaca*, *Phaeophyscia sciastra*, *Placidium acarosporoides*, *P. squamulosum*, *Polysporina lapponica*, *Rhizocarpon disporum*, and *Verrucaria compacta* (Knudsen and LaDoux 2005 & 2006; Knight et. al. 2002) At higher elevations above 1500 meters a number of montane species occur like *Buellia chloroleuca*, *Lecanora garovaglii*, *L. saligna*, *Lecidea tessellata*, *Melanohalea elegantula*, and *Xanthomendoza fallax*. Another element of the lichen flora more common in Arizona and Nevada is *Acarospora nevadensis*, *Caloplaca durietzii*, *Lecanora argopholis*, *Physcia dubia*, *Rhizoplaca peltata*, and *Rinodina juniperina*. Many mountain ranges in the southwestern Mojave Desert in southern California are rich in carbonate substrates. A few

calcareous species occur on decaying granite in washes like *Acarospora macrospora*, *Caloplaca crenulatella*, *Psora tuckermanii*, and *Toninia sedifolia*.

The Mojave Desert has an area of approximately 57,000 km (22,000 sq. miles) in Arizona, California, Nevada and Utah of Basin and Ridge topography. The washes and mountain ranges have been generally left unexplored for lichens and we expect many more interesting surveys and discoveries in the future. We plan to return to the Granite Mountains for further collecting of taxa new to science discovered in our original surveys.

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LITERATURE CITED

- André, J.C. 2006. Vascular flora of the Granite Mountains, San Bernardino County: An annotated checklist. *Crossosoma* **32(2)**: 38-74.
- Doell, J., Tucker, S., and Robertson, J. 1999. Lichens of the Sweeney Granite Mountains Desert Research Center and environs. *Bulletin of the California Lichen Society* **6(1)**: 8-12.
- Esslinger, T. L. 2007. A cumulative checklist for the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada. North Dakota State University: <http://www.ndsu.nodak.edu/instruct/esslinge/chcklst/chcklst7.htm> (First Posted 1 December 1997,

- Most Recent Update **2 April 2007**), Fargo, North Dakota.
- Etayo, J., Kocourková, J., and Knudsen, K. 2007. New Records of Lichenicolous Fungi for California. *Bulletin of the California Lichen Society* **14(2)**: 37-39.
- Knight, K.B., Clements, D.R., Gordillo, L.F., Jefferies, J.I., Tilley, D., Workman, T.J., Lloyd, A.F., and St. Clair, L.L. 2002. The lichen flora of two sites in the Mojave Desert, California, USA. *Mycotaxon* **84**: 27-32
- Knudsen, K. 2007 (2008). *Acarospora* in: Nash et al. *Lichen Flora of the Greater Sonoran Region, Volume 3*. Lichens Unlimited, Arizona State University, Tempe, Arizona. pp. 1-38. (with a 56 page insert containing 224 color photographs).
- Knudsen K. and LaDoux, T. 2005. Lichen flora of the Southwestern Mojave Desert: Key's Ranch, Joshua Tree National Park, San Bernardino County, California, USA. *Evansia* **22(3)**: 103-109.
- Knudsen, K. and LaDoux, T. 2006. Lichen flora of the southwestern Mojave Desert: Eureka Peak, Joshua Tree National park, Riverside and San Bernardino County, California. *Evansia* **23(2)**: 24-27.
- Knudsen, K. and Kocourková, J. (in prep.) A study of lichenicolous species of Polysporina.
- Nash, T.H., III, Ryan, B.D., Gries, C., and Bungartz, F. (eds.) 2002: *Lichen Flora of the Greater Sonoran Desert Region Volume 1*. Lichens Unlimited, Arizona State University, Tempe, Arizona. 532 pp.
- Nash, T.H. III, Ryan, B.D., Diederich, P., Gries, C., and Bungartz, F. (eds.) 2004: *Lichen Flora of the Greater Sonoran Desert Region Volume 2*. Lichens Unlimited, Arizona State University, Tempe, Arizona. 742 pp.
- Nash, T.H. III, Gries, C., and Bungartz, F. (eds.). 2007 (2008). *Lichen Flora of the Greater Sonoran Region, Volume 3*. Lichens Unlimited, Arizona State University, Tempe, Arizona. 575 pp. (with a 56 page insert containing 224 color photographs).
- Navarro-Rosinés, P., Calatayud, V., Hafellner, J. 2004 In: Nash, T.H., III, Ryan, B.D., Diederich, P., Gries, C., and Bungartz, F. (eds.) 2004: *Lichen Flora of the Greater Sonoran Desert Region, Volume 2*. Lichens Unlimited, Arizona State University, Tempe, Arizona, pp. 635-639.