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may substitute abbreviations of authors names, as appropriate from The International Plant Names Index - www.ipni.org/in-
dex.html. Style follows this issue. Electronic reprints in PDF format will be emailed to the lead author at no cost. The deadline
for submitting material for the summer issue is June 1, 2020.

Volume 27(2) of the Bulletin of the California Lichen Society was issued on June 21, 2021.

Cover image: *Pseudocyphellaria hawaiensis*, a rare lichen from the west coast of North America. Photo by Daphne Stone.
Pseudocyphellaria hawaiensis H. Magn.

Sponsorship for the CALS Conservation Committee

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EXECUTIVE SUMMARY

Pseudocyphellaria hawaiensis H. Magn. (figure 1) is a rare lichen in coastal western North America where it occurs in moist settings from extreme northwestern California north to southeast Alaska (figure 2). Three distinct population clusters of this lichen occur globally: in Papua New Guinea, Hawaii and the Pacific Northwest. It is rare in California and Oregon, and rare to uncommon in more northerly parts of its range. The two known occurrences in California are all in protected land within Redwood State and National Parks. Recommended conservation ranks for California are G5, S1, CNPS- List 2B.2.

TAXONOMY

Accepted scientific name
Pseudocyphellaria hawaiensis H. Magn.

Common name
Gilded Specklebelly

Type specimen and location

Synonyms
(in part) P. aurata, P. crocata, P. mougeotiana, P. perpetua.

Figure 1. Pseudocyphellaria hawaiensis.

Figure 2. Distribution of Pseudocyphellaria hawaiensis in California. Yellow circles represent reported locations.
**DESCRIPTION:**
*P. hawaiensis* from the Pacific Northwest has narrow, linear lobes, almost exclusively marginal soralia, a medulla that is white with pale yellow patches, a pale lower surface and a cyanobacterial photobiont. The upper surface is olive-brown to chocolate-brown to gray in shady microhabitats. The cortex is UV+ pale bluish; the medulla and soralia are K+ yellow, C+ orange and KC+ orange (fleeting), UV- or dark reddish. Pacific Northwest material is infertile, producing only soredia, but *P. hawaiensis* produces apothecia in Hawaii where the species is thought to have been introduced on non-native conifers (Moncada et al 2014). *Pseudocyphellaria hawaiensis* has variously been called *P. aurata*, *P. crocata*, and *P. mougeotiana*, but it is morphologically distinct from all of those species (Lücking et al. 2017). This lichen was formally described as *Pseudocyphellaria perpetua* (Miadlikowska et al. 2002), but later synonymized with *P. hawaiensis* (Moncada et al. 2014).

**SIMILAR SPECIES AND DISTINGUISHING CHARACTERISTICS:**
This lichen is part of the *Pseudocyphellaria crocata* group, of which there are three species in Western North America (Lücking et al. 2017). *Pseudocyphellaria citrina* (formerly thought to be *P. crocata* in California), is the most common and widespread species within the group. It can be distinguished by its white medulla, whereas the medulla of *P. hawaiensis* is patchily yellow. *Pseudocyphellaria holarctica* is a recently described cryptic species not yet known from California which cannot be morphologically distinguished from *P. hawaiensis* (Stone et al. 2020).

**BILOGICAL CHARACTERISTICS**

*Growth form*

Foliose, epiphytic.

*Reproductive method*

Asexually through dispersal of diaspores (soredia). Fertile material is unknown in the Pacific Northwest or California.

*Dispersal agents*

Water in the form of canopy through fall, animals and wind all could act as dispersal vectors for the diaspores.

*Substrate and specificity*

Strictly epiphytic; this lichen is found on Sitka spruce and Douglas-fir in California.

*Habitat and specificity*

Moist forests, especially streamside areas of old-growth redwood forests. All known sites have a strong association with major stream channels.

*Pollution sensitivity*

Air pollution sensitive.

*Ecological function*

Nitrogen fixation and dissemination, invertebrate food, water sequestration, carbon fixation.

**GEOGRAPHY, GLOBAL**

*Pseudocyphellaria hawaiensis* is known in Papua New Guinea, the Hawaiian Islands and coastal parts of the Pacific Northwest (Lücking et al 2017). In the American west there are numerous occurrences in coastally influenced parts of British Columbia, Canada (including the Queen Charlotte Islands), and in the United States in coastally-influenced areas of Alaska, Washington, and Oregon (CNALH 2020, Glavich et al. 2005, McCune and Geiser 2009, Lücking et al. 2017). There are two known occurrences in extreme northwest California (Wil-
Pseudocyphellaria hawaiiensis in California. UTM coordinates are Zone 10, NAD 83, and are reported ambiguously as the locations are sensitive.

<table>
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<tr>
<th>State</th>
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<td>C. Williams</td>
<td>2007</td>
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### Threats, History

The historic range of this species is unknown but was most likely greater in historic times when streamside areas of old-growth redwood forests were more widely distributed across the landscape. Historic losses of late seral Sitka spruce/Douglas-fir/ coast redwood forests in the extreme northwest of California likely coincided with destruction of historic populations.

### Threats, Future

State and National Parks are focus areas for recreation, and there is potential for accidental damage or collecting at these locations. Changes in global climate that result in drier conditions in northwest California could cause a loss of this species from California as habitat conditions change. Changes in fire regimes that result in more frequent high intensity fires are also a potential threat to the few known extant populations.

### Protection

Both known populations are secure and found on federally withdrawn lands not subject to management.

### Conservation Summary

*Pseudocyphellaria hawaiiensis* is a species that is rare across its range in near-coastal areas of the Pacific Northwest of North America with a very limited habitat and range in California. Its typical habitat becomes increasingly scarce south of Oregon. The known occurrences in California are on Congressionally Withdrawn land allocations resulting from political desig-
nations of long standing (State and National Parks). This species has NatureServe rankings in Alaska (S2), Washington (S1) and Oregon (S3).

**SPECIFIC CONSERVATION RECOMMENDATIONS:**

**RECOMMENDED GLOBAL RARITY RANK**

**G5 Secure**

Taxon is widespread occurring in parts of Asia, Oceania and North America. It might be overlooked due to its recent recognition but it is easy to identify within known Pseudocyphellaria in California.

**RECOMMENDED GLOBAL THREAT RANK**

**G5**

**RECOMMENDED LOCAL RARITY RANK**

**S1 Imperiled**

Only two small populations are known in California. Because this species is at the southern edge of its range in California, global climate change in the form of drier and warmer conditions in the redwoods could be detrimental to long-term survivability of this species in California.

**RECOMMENDED LIST**

**2B.2**

Rare in California but more common elsewhere; moderately threatened in California (California populations are not imperiled as they occur on Congressionally Withdrawn lands, however abundance at all known sites is presumed to be low).

**LITERATURE CITED**


The Real *Acarospora socialis*

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**ABSTRACT**

*Acarospora socialis* is recognized as a coastal species from central California to Baja California in Mexico. *Acarospora radicata* is not recognized as a synonym of *A. socialis*. It is the common yellow squamulose species in the New Mexican, Mojave and Sonoran Deserts. *Acarospora amabilis* and *A. rimulosa* are not recognized as synonyms of *A. socialis*.

Keywords: California distributions, Channel Islands, taxonomy.

Yellow *Acarospora* are among the most conspicuous, most photographed and most collected crustose lichens in the southwestern United States. In desert areas like Joshua Tree National Park, they are often the most common lichen. The yellow cortex is usually caused by rhizocarpic acid, with or without epanorin (Knudsen 2007). At least 102 species of *Acarosporaceae* with a yellow cortex have been described (Nurtai et al. 2019). Usually not more than one or two species occur in southwest in same general area. The Organ Mountains in New Mexico has five species of yellow *Acarospora*.

In Steve Sharnoff’s *A Field Guide to California Lichens* (Sharnoff 2014), we included pictures of two forms of *Acarospora socialis* H. Magn., in California, a coastal form and an inland form, in anticipation of future phylogenetic work. Recently, in preparing a phylogeny of *Acarospora* in New Mexico, we sequenced the common form of *A. socialis* from coastal California and the common desert form from the Mojave Desert to compare with squamulose specimens of *A. socialis* from New Mexico. We will publish our tree in a paper called "Acarosporaceae of New Mexico: four species saved from synonymy" and a new yellow species which will probably be published in 2021.

We discovered in our study that *Acarospora socialis*, whose type is from Catalina Island, is a separate species from *A. radicata*, a species that is common in the New Mexican, Mojave and Sonoran Deserts, both of which were included in the broad morphological concept of *A. socialis* in the Sonoran flora (Knudsen 2007). Both species are squamulose with a stipe and have overlapping anatomical characters and measurements. The easiest way to tell them apart is by general appearance and distribution. *Acarospora socialis* usually has one apothecium per squamule, a reddish-brown to golden yellow disc, and occurs at least along the coast from Marin County to Baja California and is the common species on the Channel Islands. How far it extends inland needs to be studied but we would not be surprised if it occurs around the Central Valley. *Acarospora radicata* generally has several apothecia per squamule with a pale yellow color, a similar hymenium height [(80-100(-135) vs 90-120(-135)μm] and usually larger squamules (1–3 mm wide versus usually 0.5–1.5 mm wide) and is common in the New Mexican, Mojave and Sonoran Deserts. In
southern California during one of the drought cycles probably since the Pleistocene for instance desert junipers migrated toward the coast as far as the Santa Monica Mountains (only one small population is extant) (Knudsen, unpublished observation). The distribution of *Acarospora radicata* may similarly extend from the desert into cismontane southern California or into the Central Valley and southern Sierra Nevada mountains through the Tehachapi corridor. So far only one other yellow species has been positively identified from California, *Acarospora robiniæ* K. Knudsen, which has a KC+ red cortex. It occurs on the Channel Islands (Catalina, Santa Cruz Island, Santa Rosa Island) and along the coast in scattered locations from Monterey Co. to Baja California including the Santa Monica and Santa Ana Mountains in southern California (J. Dart, pers. comm.; Knudsen 2007). Other species may exist in California or possible hybrids between *A. socialis* and *A. radicata*.

A problem with identifying squamulose species of *Acarospora* is variations caused by environmental conditions. In poor microhabitats squamulose species can be reduced in size, have a low hymenium, and can be broadly attached to the substrate, lacking a stipe. The holotype of *A. intercedens* H. Magn., a synonym of *A. socialis*, is just such a poorly developed specimen. Squamules of *A. socialis* can have more than one apothecium in apparently more favorable habitats where squamules grow larger to 2 mm in width before they divide. Especially in *A. socialis* there is variation in the color of discs, depending on concentrations of rhizocarpic acid in ephymenium. This probably is caused by insolation. The *A. socialis* photographed for this article has reddish brown apothecia from the color of the ephymenium to the human eye but the camera makes them look yellow because the rhizocarpic acid reflects the light.

In identifying Acarosporaceae microscopic characters such as hymenium height, width of parathecium, hymenial gel reaction to Lugol’s, even the height of subhymenium, can be diagnostic characters. The characters of ascospore size, while very useful in many fungal genera are only useful in relatively few species of Acarosporaceae with globose or broadly ellipsoid ascospores, or very large or very small ascospores. In some species, like several *A. strigata* group taxa or the European lichenicolous lichen *Acarospora mayrhoferi* K. Knudsen & Kocourková, spore development begins as globose but can become ellipsoid (Knudsen & Kocourková 2018). Viable ascospores can be released at different stages of development, probably depending on conditions of rainfall. As you can see from the overlapping descrip-
tions of *A. socialis* and *A. radicata* some specimens, if the species are sympatric, may be impossible to identify.

Another problem with identifying genera like *Acarospora* or *Verrucaria* or any genus or family is it requires experience with the group. When we are doing inventories, we group specimens by probable genus, e.g. *Xanthoparmelia* or *Buellia*, and work on all probable specimens from one genus at a time. It is efficient and a great experience for learning.

**Taxonomy**


**Description**

Thallus of squamules with stipe, indeterminate, contiguous or dispersed, squamules usually 0.5–1.5 mm wide, 0.3–0.8 mm thick, rarely larger, replicating by division. Upper surface yel-

low to greenish yellow, usually epruinose, smooth. Lower surface white to brown. Epicutex continuous, ca. 5 μm thick. Cortex 40–70(–90) μm, cells round to angular, 3–5 μm wide, of usually disarticulated hyphae, upper layer yellow, lower layer hyaline. Algal layer even, 100–200 μm thick. Medulla up to 300 μm thick, hyphae continuous with stipe.

Apothecia usually one per squamule but sometimes 2–4, disc dark reddish brown to a golden yellow, epruinose. Parathecium expanding to up to 100 μm around disc, sometimes forming a margin or parathecial crown around disc, same color as thallus. Hymenium 90–120(–135) μm high, hymenial gel hemiamyloid (IKI+ blue turning red or red in squash preparation), paraphyses ca. 2.0 μm wide. Asci 60–85 × 14–17 μm, ascospores several hundred per ascus, usually 4–5 × 2.0 μm, variable. Subhy-
menium IKI+ dark blue, 30–80 µm tall, variable. Hypothecium narrow.

Pycnidia frequent, usually visible as black dots, conidia mostly 1–1.5 × 0.5 µm.

Chemistry
Rhizocarpic acid (major). Not producing other secondary metabolites. Spot tests negative.

Distribution and Ecology
Acarospora socialis occurs from at least Marin County to Baja California in Mexico along the coast and in the coastal ranges on siliceous rock in full sun. Inland distribution range needs to be determined.

Discussion
Magnusson often used unnaturally narrow hymenial heights for determining species (Knudsen 2004). *Acarospora socialis* has a normal range of variation of at least 55 µm in height of hymenium (90–100–120(–135) µm high. The height of hymenium is influenced by the size of squamules which depends on favorable or unfavorable environmental conditions. The two species *A. evoluta* and *A. intercedens* were apparently described because they had a higher (*A. evoluta*) or shorter (*A. intercedens*) hymenium than usual in *A. socialis*. *Acarospora subalbida*, described from a H.E. Hasse collection from Topanga Canyon in the Santa Monica Mountains, is typical of some specimens found in Santa Monica Mountains in depressions on top of boulders, where they typically become pruinose from the evaporation of rainwater. All three are synonyms of *A. socialis*. Two synonyms of *A. socialis* in the Sonoran Flora (Knudsen 2007) have been revised and are no longer recognized as synonyms: *A. amabilis* H. Magn. is a good species and a revision will be published in our Organ Mountain Acarosporaceae paper. *Acarospora rimulosa* H. Magn. is most likely a synonym of *A. chrysops* H. Magn. and is a problem currently under study.

Selected specimens studied. U.S.A. CALIFORNIA. Monterey Co., South of Big Sur, Santa Lucia Mountains, mouth of Anderson Canyon, 36° 49’ 11” N 121° 39’ 60” W, 15 m, on quartzite cliffs and boulders, 24 Nov. 2014, T. Wheeler 6650 (hb. Wheeler); Cholame Valley, east side of Cholame Creek, 35° 49’ 54” N 120° 21’ 26” W, 398 m, on granite, J. Dart 564 (hb. Dart, hb. K&K); Santa Barbara Co., Santa Rosa Island, pass along the main road just SE of Black Mountain, 33° 58’ 45” N 120° 4’ 30” W, 300 m, on rhyolite tuff, 1 Jan. 1994, T.H. Nash III 32644 (ASU, hb. K&K); Ventura Co., Santa Monica Mountains, Point Mugu State Park: below cliffs above high tide level, 34° 5’ 55” N 119° 4’ 35” W, 6 m, on layered siliceous slabs, 10 Oct. 2005, K. Knudsen 4066 & M. Knudsen (UCR, hb. K&K)


Description
Thallus up to several centimeters in width and capable of expanding to at least 10 cm by replication by division, areoles or squamules 3–5 mm wide, up to 2.0 mm thick, sometimes imbricate. Upper surface yellow, epruinose, smooth, often with fissures, eventually replicating by division. Lower surface white or brown, ecorticate. Epicortex thin, ca. 10 µm, continuous, or absent. Cortex 50–90 µm tall, upper layer yellow up to 30 µm thick, lower layer hyaline, cells mostly round, 3–5 µm wide. Algal
layer 100–130 µm tall, upper and lower surface usually even, dense, algal cells ca. 10–14 µm wide. Medulla 200–300 µm thick, narrowing into mycelial base or stipe up to 300–500 µm tall, obscure with crystals and gelatinization, hyphae mostly 2 µm wide, thin-walled.

Apothecia often rare, but sometimes abundant, one to seven per areole, 0.2–1.0 mm wide, disc yellow to dark blackish red, epruinose, rarely with ontogenic remnants of cortex on surface. Paraphycium expanding around the disc up to 100 µm, usually rising slightly above adjoining cortex, same color as thallus, IKI-. Hymenium (80-)100(-135) µm high, ephymenum yellow to reddish yellow, 10–30 µm high, the yellow pigment sometimes extending downward into hymenium 40–50 µm, paraphyses 1–2 µm wide, apices unexpanded, hymenial gel IKI+ red or blue turning red (hemiamyloid). Ascii 90–130 × 14–20 µm, clavate, several hundred ascospores per ascus, ascospores, ascospores ellipsoid, mostly 3–4 × 1.0–1.5 µm, often two oil drops. Subhymenium 50–90 µm tall, persistently IKI+ blue. Hypothecium narrow, 10–20 µm wide, hyphae continuous with stipe, IKI-.

Pycnidia common, ostiole not visible, globose to ovate, 60–120 µm wide, conidiogenous cells amphiorm 14–20 × 1.0–1.5 µm, conidia mostly globose 1 µm wide.

Chemistry
Rhizocarpic acid (major). Not producing other secondary metabolites. Spot tests negative.

Distribution and Ecology
Common at least in California and Arizona in Mojave and Sonoran Deserts, and in New Mexico, on siliceous rock in full sun. Full range needs to be determined.

For discussion about this species see Knudsen et al. in preparation.

Selected specimens examined. U.S.A. CALIFORNIA. Riverside Co., Mojave Desert, Joshua Tree National Park, north-facing slope of Little San Bernardino Mountains, Geology Tour Road Marker 14, 33° 54' 11.2" N 116° 07' 04.7" W, 1363 m, on gneiss, K. Knudsen 12706 (UCR); Sheep's Pass, 34° 00' 06.5" N 116° 07'11.9" W, 1363 m, on granite, 18 Dec. 2010, K. Knudsen 13135 (UCR, hb. K&K); San Bernardino Co., Joshua Tree National Park, Indian Cove, Rattlesnake Canyon, 34° 05' 04.5" N 116° 08' 24.3" W, 922 m, abundant on granite, 28 Dec. 2010, K. Knudsen 13428 (UCR).

CONCLUSION
A further study of A. socialis is beyond the scope of our current grant and we are offering this spinoff of our New Mexican research as a public service.

ACKNOWLEDGEMENTS
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LITERATURE CITED
New Reports of Great Basin Desert Lichens in California

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ABSTRACT
Recent fieldwork in the Great Basin Desert has begun to fill a large gap in North American lichenology. This region includes parts of several counties in extreme eastern California that have been historically neglected by lichenologists. Eight species are reported new to California: Acarospora tintickiana, Aspicilia boykinii, Calogaya ferrugineoides, Glypholecia scabra, Lecanora atromarginata, Rhizocarpon atrovirellum, R. intermediellum and Seirophora contortuplicata.

INTRODUCTION
Nevada is a giant blind spot in lichenology. Flipping through the pages of Lichens of North America (Brodo et al. 2001), one soon notices that the distribution map of many western species has a conspicuous, artificial hole over Nevada. Particularly striking examples include Lecanora piniperda Körber, Lecidella stigmataea (Ach.) Hertel & Leuckert, Melanelia elegantula (Zahlbr.) Essl., Physcia biziana (A. Massal.) Zahlbr., P. caesia (Hoffm.) Hampe ex Fürmr., Physconia perisidiosa (Erichsen) Moberg and Toninia sedifolia (Scop.) Timdal, which are all very common species in Nevada (pers. obs.). Indeed, prior to the publication of that landmark book in 2001, the Consortium of North American Lichen Herbaria (CNALH 2019) lists only 2,255 distinct collections by 67 collectors in Nevada. Six years later, Peterson & Ryan (2007) reported only 185 species in their preliminary inventory.

Is this 110,567 mi² (286,367 km²) region, which is mostly within the Great Basin Desert ecoregion, such a lichen desert? Indeed, the name of the ecoregion suggests an enormous featureless basin, filled with nothing but sand dunes, barren rocks, tumbleweed, and an eerily loud silence. But if you look at the topography of the Great Basin Desert, you’ll quickly see that it’s anything but flat. The “basin” in its name applies to the hydrology – not the terrain. Nevada has over 70 mountain ranges, and is considered the most mountainous state in the conterminous United States. Each mountain chain is distinct, with its own unique geology, together constituting the continent’s only geological rift system (think of the Rift Valley in Africa). And these are not tiny hills – many mountain ranges tower 5,000–10,000 ft (1,500–3,000 m) above the aluvial basins lying between them.

With such varied topography and geology, and with lichens’ knack for thriving in extreme conditions, surely the lichens of this region must be much more diverse than the literature records. In 2014, we moved to Reno, Nevada to start filling that gap in knowledge.

Over the subsequent five years of fieldwork, primarily in the Great Basin Desert, we uncovered a rich and distinctive lichen flora. We are finally ready to start sharing what we have learned. Later this year, together with several other western lichenologists, we will publish an updated checklist for Nevada. Additional pub-
lications in the works include the characterization of a novel lichen community found around the margins of playas, a revision of the desert species of *Anaptychia*, and a nontechnical field guide to the common lichens of the Great Basin Desert.

Our fieldwork occasionally takes us into the extreme eastern and northeastern parts of California, where the Great Basin Desert gives way to the Sierra Nevada in the south and to the Modoc Plateau in the north. This eastern edge of California has historically been neglected just like Nevada.

The easiest way to find the boundary between the California Floristic Province and the Great Basin Desert is to drive east and watch the oaks: where the oaks end, the Great Basin Desert begins. The transition from the Mediterranean climate that characterizes most of California to the more continental climate of the Great Basin Desert is often remarkably abrupt. In the Sierra Nevada and on the Modoc Plateau precipitation occurs almost exclusively in the winter months, often as snow. In the western Great Basin Desert an equal amount of precipitation characteristically occurs in the summer, mostly as warm, monsoonal afternoon thunderstorms. Total precipitation falls off equally abruptly from west to east, because the Sierra Nevada Mountains and the Warner Mountains on the eastern edge of the Modoc Plateau\(^1\) cast strong rain shadows, squeezing the moisture out of winter storms coming off of the Pacific Ocean (Figure 1).

\(^1\)Technically, the area in the lee of the Warner Mountains and northward into central Oregon is considered Northern Basin and Range, while most of Nevada is Central Basin and Range (EPA 2015). We have not explored the differences between these two regions yet.

![Figure 1. Map of the seasonality of precipitation in southwestern North America. Most of California (dark blue / dark gray) receives almost all its precipitation in the winter as snow at high elevation and cold rain at low elevation. Eastward (green and yellow / light gray) winter storms are reduced by the rain shadow effect and are replaced increasingly by summer rains in the form of thunderstorms fueled by moisture from the Gulf of California and even the Gulf of Mexico. The Rockies (brown and red / dark gray) receive most of their total precipitation in the summer. Great Basin collection sites mentioned in this paper are indicated by stars: 1. Warner Mountains and Alkali Lake, 2. Madeleine Plains, 3. Honey Lake, 4. White Mountains, 5. Inyo Mountains. Precipitation seasonality index was calculated from 30-year average monthly precipitation data (PRISM 2013). Map produced using an unpublished GIS package developed by the authors.](image-url)
Precipitation supports several distinct vegetation communities. Salt-scrub occurs around playas (Atriplex spp., Sarcobatus vermiculatus (Hook.) Torr.). Various sagebrush communities dominate in the valleys and foothills (Artemisia spp.). Pinyon-juniper woodlands (Pinus monophylla Torr. & Frem., Juniperus osteosperma (Torr. Little) take over at intermediate elevations (Figure 2), finally giving way to montane forest (Abies concolor (Gord. & Glend.) Lindl. ex Hildebr., Pinus longaeva D.K. Bailey, Populus tremuloides Michx.) at high elevations. At the top of the highest mountain ranges trees disappear and are replaced by alpine habitats. Geology is highly diverse, including both sedimentary (limestone, quartzite and shale/mudstone mostly) and extensive volcanics (basalt, andesite, rhyolite) – often in a dense, complex mosaic.

What lichens are found there? Most of the diversity occurs on siliceous rocks: a colorful assemblage including especially Acarospora rosalata (Th. Fr.) H. Magn., Aspicilia nasii Owe-Larsson & A. Nordin, Candelariella rosulans (Müll. Arg.) Zahlbr., Dimelaena oreina (Ach.) Norman, Lecideaatrobrunnea (Ramond ex Lam. & DC.) Schaerer, Pleopsisimum flavum (Bellardii) Körber, Protoparmeliopsis garovaglilii (Körber) Arup, Zhao Xin & Lumbsch (= Leccanora garovaglilii (Körber) Zahlbr.), Rhizocarpon disporum (Nägeli ex Hepp) Müll. Arg., Rhizoplaca melanophthalma (DC.) Leuckert & Poelt, and Rasovskia elegans (Link) S. Y. Kondr. & Kärnefelt (= Xanthoria elegans (Link) Th. Fr.).

Calcareous rocks support a more understated community, particularly Acarospora striigata (Nyl.) Jatta, Calogaya biatorina (A. Massal.) Arup, Frödén & Soehnting (= Calopla ca biatorina (A. Massal.) J. Steiner), Lecidella patavina (A. Massal.) Knoph & Leuckert, Lichinella nigrithela (Lettau) P. P. Moreno & Egea, Polyosphora urceolata (Anzi) Brodo, Rinodina bischofii (Hepp) A. Massal., Staurothele monicae (Zahlbr.) Wetmore, and Xanthocarpia crenulatella (Nyl.) Frödén, Arup & Soehnting (= Calopla ca crenulatella (Nyl.) H. Oliver).

Junipers support by far the richest epiphyte community thanks to their long-lived, weathered dead branches. In addition to several problematic Calopla ca spp. these are all common: Candelariella antennaria Räsänen, Melanohalea elegantula (Zahlbr.) O. Blanco et al., Phaeophyscia nigricans (Flörke) Moberg, Physcia dimidiata (Arnold) Nyl., Rinodina grandilocularis Sheard, and Xanthomendoza galericulata L. Lindblom.

There are similar communities on sagebrush and other desert shrubs but you really have to work for it, as lichens like to hide in the most sheltered spots deep within the bushes, presumably where moisture holds out longest after rain events – light is not limiting in deserts! Pinyons host a rather different and much smaller com-
munity dominated by *Lecanora saligna* (Schrader) Zahlbr. and *Melanohalea subolivacea* (Nyl.) O. Blanco et al.

That leaves soil crusts — yes, despite common convictions that suggest otherwise, terricolous lichens are relatively diverse and abundant in the Great Basin, you just have to know where to look. Prime locations are rock ledges, relict ungrazed sites, fenced enclosures around mines, and sagebrush sites which have been so altered by grazing that the hydrology and soils no longer support much forage of any kind, not even weedy cheatgrass (*Bromus tectorum* L.), and hence have not been trampled in recent decades. The most common soil crust species are *Enchylium coccophorum* (Tuck.) Otálor, P. M. Jørg. & Wedin (= Collema coccophorum Tuck.), *Peccantia subnigra* (B. de Lèsd.) Wetmore, *Peltula patellata* (Bagl.) Swinscow & Krog, *Placidium lacinulatum* (Ach.) Breuss, and *Psora decipiens* (Hedwig) Hoffm.

We’ve only scratched the surface of the Great Basin Desert lichen flora. There’s so much more to be found. And like words on a page, lichens can help us read these desert landscapes.

**NEW REPORTS FOR CALIFORNIA**

*Acarospora tintickiana* St. Clair, Newberry & S. Leavitt. INYO COUNTY: White Mountains, Cedar Flats, on limestone outcrop in *Pinus monophylla* woodland, *J. Hollinger* 22058 & N. Noell (ASU); Inyo Mountains, near Malpais Mesa, on craggy limestone ridge in Mojave–Great Basin ecotone, *J. Hollinger* 22065 & M. Jesus (Figure 3A). *A. tintickiana* most closely resembles a strongly pruinose form of *A. rosulata,* another common Great Basin Desert species that also forms handsome rosettes, strongly convex areoles and contains gyrophoric acid (C+ pink). *A. tintickiana* was recently de-

scribed by Leavitt et al. (2018) from western Utah and eastern Nevada. It is a common and characteristic species of exposed, north-facing, hard limestone at low to middle elevations (mostly 1,500–2,400 m) in the Great Basin Desert. It is not surprising to find it in typical habitat in extreme eastern California, suggesting that it is only rare in western Nevada because of the relative scarcity of limestone in this region.

**Aspicilia boykinii** Owe-Larsson & A. Nordin. INYO COUNTY: Inyo Mountains, near Malpais Mesa, on craggy limestone ridge in Mojave–Great Basin ecotone, *J. Hollinger* 22066 & M. Jesus (ASU); MODOC COUNTY: Warner Mountains, near Cedarville, on volcanic breccia in Great Basin Desert, *J. Hollinger* 22643 & 22644 (BRY-C) (Figure 3B). *A. boykinii* is unique among California *Aspicilia* in its strongly pruinose, orbitalar, determinate thallus. *A. boykinii* is most reliably distinguished from *A. determinata* (H. Magn.) N. S. Golubk. in lacking algae below the hymenium, and occasionally the presence of stictic and/or norstictic acid. The more northern *A. candida* (Anzi) Hue is also similar, but it has larger spores and less moniliform paraphyses (Owe-Larsson et al. 2007). *A. boykinii* was described from the Grand Canyon. It is common on calcareous rocks of all types in the Great Basin Desert and Colorado Plateau.

**Calogaya ferrugineoides** (H. Magn.) Arup, Fröden & Sochting (= *Caloplasca ferrugineoides* H. Magn.), INYO COUNTY: Inyo Mountains, between Malpais Mesa and Conglomerate Mesa, on *Artemisia nova*, *J. Hollinger* 22070a & M. Jesus; LASSEN COUNTY: Honey Lake Valley, 8 km S of CalNeva, on *Sarcobatus* (*J. Hollinger* 22635) and *Artemisia* (*J. Hollinger* 22636); Madeline Plains, 6.5 km N of Ravendale, on *Artemisia* (*J. Hollinger* 22638h);
Figure 3. A. Acarospora tintickiana (Hollinger 22065 from Inyo Mts.); B. Aspicillia boykinii (Hollinger 22643 from the Warner Mountains); C–E. Calagaya ferrugineoides (Hollinger 8091b from Buffalo Valley in central Nevada), note narrow spore septum and hollow area below hymenium; F. Glypholecia scabra (Hollinger 12673 from Highland Peak in eastern Nevada); G. Lecanora atromarginata (Hollinger 22656 from the Warner Mountains). Scale bars: A, B, F, G = 5 mm, C = 1 mm, D = 100 μm, E = 10 μm.
MODOC COUNTY: Middle Alkali Lake, E edge of lake near road, on Sarcobatus (J. Hollinger 22657d) and Atriplex confertifolia (J. Hollinger 22658a sub Rinodina lobulata) (Figures 3C–E). On our first trip out while moving to Reno, we stopped at Sevier Lake, a massive salt playa in western Utah. It was easily the most desolate landscape we had ever seen! Surely no lichens can survive in this habitat. So far as we can tell, we were the first lichenologists ever to test that hypothesis. In fact, it is dead wrong. There is a small but very faithful assemblage of species that grow right at the edge of playas (dried ephemeral lake beds) throughout the Great Basin Desert (Figures 4–5). In many cases, exclusively within a stone’s throw of the margin. We have since surveyed several dozen playas throughout the region, and each time this handsome species greeted us. It was previously known from desert shrub steppe in Central Asia. It is superficially most similar to Athallia pyracea (Ach.) Arup, Frödén & Söchting (= Caloplaca pyracea (Ach.) Zwackh, often included in C. holocarpa (Hoffm. ex Ach.) A. E. Wade in North America), with scant orangish thallus and bright orange apothecia, but unlike A. pyracea, C. ferrugineoides is ± hollow beneath the apothecia (with very similar anatomy to the closely related C. biatorina) and its spores have a narrow septum (2–2.5 μm). In the Great Basin Desert it grows on many desert shrubs and occasionally Juniper but is most abundant on Sarcobatus vermiculatus.

Figure 4. Honey Lake Valley. Typical salt scrub habitat at the margin of a small playa, here mostly Black Greasewood (Sarcobatus vermiculatus).

Glypholecia scabra (Pers.) Müll. Arg. INYO COUNTY: Inyo Mountains, near Malpais Mesa, on basalt outcrop in Mojave wash, J. Hollinger 22061 & M. Jesus (ASU); SAN BERNARDINO COUNTY: Clark Mountains, ridge below Clyde peak in pinyon pine woodland, Kerry Knudsen 11742 (UCR, not seen) (Figure 3F). This is a very distinctive umbilicate species with crazy gyrose, pruinose, brown apothecia, unlikely to be confused with anything else. It is widespread but particularly common in the Great Basin Desert and Colorado Plateau. It has a preference for calcareous substrates, but in our experience it is more often found on neutral or even siliceous rocks with calcareous modification, such as in washes and at the base of cliffs. Wind blown dust and silt may encourage the
growth of this lichen on non-calcareous substrates (Rosentretre 1990).

*Lecanora atromarginata* (H. Magn.) Hertel & Rambold. MODOC COUNTY: Warner Mountains, near Cedarville, on vertical volcanic breccia in Great Basin Desert, *J. Hollinger* 22656 (Figure 3G). This is a beautiful species that forms striking yellowish-white, continuous crusts with a distinct, thin, black prothalline margin. The apothecia often appear to be lecideine, but are at least initially immersed with an obscure lecanorine margin. *Lecanora atromarginata* differs from the very similar *L. marginata* (Schäfer) Hertel & Rambold primarily in chemistry: the latter containing atranorin, usnic acid and terpenoids (McCune 2017), ours contains usnic, stictic and substictic acids.

*Rhizocarpon atrovirellum* (Nyl.) Zahlbr. MODOC COUNTY: Warner Mountains, near Cedarville, on *Aspiciilia knudsenii* on volcanic breccia in Great Basin Desert, *J. Hollinger* 22641 (Figure 6A). This and the next species are very similar: both are initially parasitic yellow species with small, dark, 3-septate to submuriform spores ca. 12–21 × 6–10 μm. McCune (2017) calls attention to the presence of coarse black granules in the ephymenium of *R. atrovirellum*, apothecia often surrounded by a thalline collar, and its relatively small thalli, citing a single specimen in North America from western Montana (a high-quality Tim Wheeler photo is available online). We have found ten specimens in the Great Basin Desert all at least initially parasitic on the *Circinaria “desertorum”* complex, all with identical morphology of small clusters of strongly convex areoles and bulging apothecia completely surrounded by thalline collars. But we have not noted the presence of black granules in the ephymenium (although they may be obscured by intense pigment). By contrast, there is another taxon with typically paler yellow thallus, and which forms larger, more regular thalli, often with black prothallus and relatively flat areoles, and whose apothecia are at least in part not surrounded by thalline collars. This latter material parasitizes a much larger range of species (including a broader selection of *Aspiciilia* s. lato, gray *Rhizocarpon* spp. and *Staurothecia* spp.) and occupies a much broader ecological range. We are tentatively applying the name *R. atrovirellum* to the distinctive Great Basin Desert species, and *R. intermediellum* to the rest. We would not be surprised to find that the latter material comprises more than one taxon. Two forms are shown in Figures 6B–C.

*Rhizocarpon intermediellum* Räsänen. INYO COUNTY: Bishop Pass, on granite in alpine, *J. Hollinger* 14828 (NY); Mount Whitney, summit, on granite, *J. Hollinger* 14912, 14913 (NY) and 14953 (MSC); Piute Pass, on granite in alpine, *J. Hollinger* 18193 (MSC); MODOC COUNTY: Warner Mountains, near Cedarville, on volcanic breccia in Great Basin Desert, *J. Hollinger* 22642 (BRY-C); MONO COUNTY: Mount Dana, summit, on metamorphic talus, *J. Hollinger* 17634 (MSC); Parker Pass, on metamorphic rock in alpine, *J. Hollinger* 17773 (MSC); TUOLUMNE COUNTY: Mammoth Peak, on granite in alpine, *J. Hollinger* 17671 (MSC) (Figures 6B–C). See notes above under *R. atrovirellum*.

*Seiophora contortuplicata* (Ach.) Fröden. INYO COUNTY: Inyo Mountains, near Malpais Mesa, on basalt in Mojave wash, *J. Hollinger* 22060 & *M. Jesus* (ASU); MODOC COUNTY: Warner Mountains, near Cedarville, on volcanic rock in Great Basin Desert, *J. Hollinger* 22647 (BRY-C) (Figure 6D). This species was once included in *Teloschistes* owing to its distinctive,
orange, fruticose thallus. It is one of a handful of fruticose desert lichens, including especially \textit{Pachyplettis cladodes} (Tuck.) Söchting, Frödén & Arup (= \textit{Calopla}ca \textit{cladodes} (Tuck.) Zahlbr.) and a bushy desert form of \textit{Physcia tenella} (Scop.) DC. At first glance this may seem strange, as fruticose lichens are typically associated with misty locales, high humidity and strong ambient light, such as the California fog belt. \textit{Seirophora contortuplicata} has managed to find a narrow niche in the desert with functionally similar conditions: sheltered crevices and nooks high on exposed north-facing cliffs. These microsites never receive direct rain or sunlight, but they retain moisture in cracks and pores, long after rain events and have strong indirect illumination. As Wright (2000) predicted, we had no trouble locating multiple robust populations of this species in typical habitat in the Inyo, White and Warner Mountains. It is widely considered a calciphile, and indeed it is often found growing directly on limestone (Rosenreter & McCune 1996, McCune et al. 2014). However, sheltered crevices, even of siliceous rock types like rhyolite, often display some calcareous modification in the Great Basin Desert,
and our records show that it is equally common on all kinds of rock from quartzite and granite to volcanic ash and limestone. Calcareous dust and windblown silt may add nutrients to such non-calcareous substrates.

**LITERATURE CITED**


Like bird watching, insect collecting, and mushroom foraging, hunting for and identifying lichens during hikes is rewarding and fascinating. As citizen science platforms like iNaturalist inspire people to document and share the lichens they discover, a greater number of people are on the hunt to add new species to their lists. There are numerous methods that seasoned amateurs and lichenologists alike use to identify lichens. The most accessible way is by sight alone, by eye or using a hand lens to look at different morphological features, like growth form, color, and reproductive structures.

Beyond that, there are additional layers of complexity to identifying lichens that require more advanced tools. Even some of the most beginner-friendly lichen identification books call for doing spot tests on lichen thalli using chemicals, some of which are neither readily accessible nor safe to bring to the field. Many species require a closer look at reproductive structures and spores with a microscope and the utmost precision. Thin-layer chromatography (TLC) is a technique used to separate and identify the variety of secondary metabolites a lichen is composed of and can be essential for identifying some species beyond genus. Approximately 1000 different secondary metabolites have been detected in lichens so far (Goga et al. 2018).

Additionally, with advances in DNA sequencing, a prominent issue has emerged across kingdoms: morphology-based classifications are commonly not supported by DNA. This is often due to convergent evolution, which is when a trait has evolved independently more than once. In lichens, the typical characters used for identification—ascocarp type, reproductive mode, asci characters, ascospore morphology, thallus morphology—often have evolved independently multiple times, and therefore are not taxonomically useful (reviewed in Prinzen 2010, Lumbsch et al. 2011). Even secondary metabolites do not often reflect an underlying evolutionary relationship (Prinzen 2010). Because of how misleading convergently evolved characters are, the number of lichen species has likely been underestimated (Lumbsch and Leavitt 2011). Furthermore, morphology-based classification with lichens can be especially challenging because they are composite organisms that reflect the intersection of multiple evolutionary histories, that of the mycobionts and photobionts.

One type of convergent evolution that molecular analysis has revealed to be common among lichens is cryptic speciation, when two or more species look similar but are distinct species. Numerous studies have found cryptic species across genera of lichen-forming fungi (Arguello et al. 2007, Crespo and Pérez-Ortega 2010, DelPrado et al. 2019, Kraichak et al. 2015, Kroken and Taylor 2001, Leavitt et al. 2016b, Parmen et al. 2012, Singh et al. 2015, Wirtz et al. 2008, Zhao et al. 2017). The mechanisms behind cryptic speciation in lichens are still largely unknown; perhaps it’s because of similar adaptive
pressures in the environment (Bickford et al. 2007, Osyczka and Rola 2013) and/or lichens are only able to evolve a limited “suite of characters” (Crespo and Pérez-Ortega 2010).

As a case example, let’s look at the most diverse genus of lichen-forming fungi, Xanthoparmelia, which is comprised of over 800 described species (Lücking et al. 2017, Thell et al. 2012). While morphological characters are useful for delimiting monophyletic groups within its family Parmeliaceae, the utility is lost in generic- and species-level descriptions (Blanco et al. 2006). In the past, species delimitation using morphological characters of Xanthoparmelia has been found to be problematic; due to the variability within the genus many of these characters likely are not as taxonomically valuable as previously assumed. Many morphological and chemical characters that were once used for taxonomy (e.g. atratorin, usnic acid, pored epicortex, pseudocyphelae) have been found to be gained and lost several times during the diversification of Parmeliaceae (Blanco et al. 2006, Del Prado et al. 2007, Divakar et al. 2015a).

On the other side of the coin are lichens that look different but are actually the same species, as revealed by molecular analysis, due to a plasticity of morphological characters. The individuals might look different due to differing photobionts (Ertz et al. 2018) or perhaps they are composed of similar symbionts that are responding to different environmental pressures (Lumbsch and Leavitt 2011). Previously, lichenologists have theorized about the existence of species pairs, lichens that look similar except that one species is sexually reproductive and the other asexual. However, some studies propose that sometimes they are not two different species after all (Buschbom and Mueller 2006, Crespo and Pérez-Ortega 2010, Otalora et al. 2017)—they might simply be the same species with a variable reproductive mode (Lumbsch and Leavitt 2011). For example, Otalora et al. (2017) analyzed species of Pectina in Europe and northern Africa and found that the reproductive mode was not an accurate predictor of monophyly, ultimately proposing that species be re-circumscribed to include sexual and asexual individuals in each species group.

How does one classify or identify lichens when the lichens lack the morphological characters to differentiate them? Some species, especially those which were once thought to be cosmopolitan, have geographic distributions that reflect their evolutionary lineages (Alors et al. 2016, Arguello et al. 2007, Singh et al. 2015, Vondrak et al. 2009). For example, Alors et al. (2016) proposed that Punctelia rudectia sensu lato be delimited based on different lineages found in North America, the Canary Islands, South Africa, and Asia and East Africa. Other lichens can be distinguished by their substrate (Molina et al. 2007). But many species are tricky to distinguish without the assistance of molecular analysis.

DNA sequencing has yielded a better understanding of species boundaries and evolutionary relationships between species. DNA can be sequenced from a fragment of the lichen thallus, and its sequence is then compared to other sequences in a DNA reference database. A close match suggests it is the same species or at least closely related. Some lichen species are now being described using primarily DNA characters (Leavitt et al. 2016a). Where morphology can be a superficial classification, DNA sequencing enables researchers to dig deeper into evolutionary relationships. Additionally, DNA barcoding the internal transcriber sequence
(Schoch et al. 2012) of lichen-forming fungi enables relatively quick surveys so researchers don’t have to sequence the entire genome to identify it (Divakar et al. 2015b, Wright et al. 2019), and a barcode distance method may even be useful for identifying cryptic diversity in lichens (Del-Prado et al. 2019).

DNA sequencing has been invaluable for the circumscription of species. While species circumscription can seem frivolous, it is essential to be able to accurately identify lichens for conservation, air pollution monitoring, and pharmaceutical development. The diversity of secondary metabolites has potential in pharmaceutical development, from the usnic acid in some species having antibacterial properties (Tabbabi and Karmous 2016) to the lichen-based antioxidants showing utility for cancer management (Solarova et al. 2020). In a study by Puy-Alquiza et al. (2016), Xanthoparmelia mexicana was used to quantify polycyclic aromatic hydrocarbons in urban tunnels, determining relatively high toxicity in tunnels that up to 7000 people walked through daily. These are all promising areas of research that benefit from the precision offered by DNA-based species circumscription, especially when research teams might not include trained lichenologists.

Although molecular analysis has changed the way lichens are studied, there are numerous problems that must be acknowledged. First, there remain the problems of incomplete reference databases and incorrect information on these databases. Currently, the National Center for Biotechnology Information (NCBI) database is one of the most used databases for accessing publicly available sequences. Unfortunately, the NCBI database is riddled with errors (Nilssson et al. 2006). Beyond that, there are hurdles to overcome with the genomes themselves. Different genes often have different histories and different substitution rates, so the inferred relatedness between species can change depending on the genes sequenced. It can be challenging to differentiate between recently diverged species or species that have evolved as a result of a rapid radiation because the selected genes might lack variability between species. And while DNA barcoding might be an acceptable intermediary between morphological identification and full-blown sequencing, it too suffers from the aforementioned problems and more (Yahr et al. 2016).

I entered the ivory towers of academia because I found joy in hiking at a snail’s pace to survey and identify the lichens around me, and I wanted to learn more about them. I am the type who is content standing in one spot for an hour, just to revel in the wide diversity of life growing on a single rock. Learning the names of each species I encounter is a way of gaining familiarity, like learning someone’s name is the first step toward becoming their friend. And while I am grateful for the opportunity to learn more about the complexities of lichens in an academic setting, it can be maddening to also learn how messy they truly can be. How does one maintain the joy and excitement of seeking and identifying lichens while knowing that we might not be calling them by the right name?

For me, this has meant shifting the goals I have during slow hikes: rather than learning names, I pay attention to patterns. Why do some forms of lichens thrive in wet, moss-covered nooks and crannies while other are found on man-made structures that receive full days of sunlight? I witness lichens growing along my favorite trails or on neighborhood rocks, noticing how they fit into the micro- and macro-landscape.
For others, this can mean staying active on iNaturalist to see how species names shift over time. It can mean continuing to attend CALS meetings to learn more about neighborhood lichens. With DNA sequencers becoming smaller and smaller (like the pocket-sized MinION), perhaps the future of citizen-based lichenology means collecting and contributing DNA to public databases to help round out the collections of DNA sequences. While the complexity and the unknown of lichens can be frustrating at times, it’s exciting to think about all that we have yet to learn about how bizarre and diverse lichens truly are.

**LITERATURE CITED**


Tabbabi, K., & T. Karmous. 2016. Characterization and Identification of the components extracted from 28 lichens in Tunisia by high performance thin-layer chromatography (HPTLC), morphologic determination of the species and study of the antibiotic effects of usnic acid. Medicinal & Aromatic Plants 05.


Irene Winston, long-term CALS member, passed away in November, 2020

Many of us have an image from CALS outings of Irene Winston as a small woman carrying a big book; Irene was one of a very few lichen enthusiasts willing to lug her nine-pound copy of *Lichens of North America* into the field. She has been one of our most active members, despite a shyness that made it easy to miss her deep intelligence and devotion to lichenology.

Irene (right) and Alice Gore at Tilden Regional Park workshop.

Irene Winston was a science teacher with a master’s degree in botany and education from California State University East Bay (Hayward). She was a long-term docent at the Tilden Regional Park Botanic Garden in Berkeley. She co-authored with Esther Railton-Rice a guidebook for early childhood educators titled *Pumpkins and Petunias*, which included an activity list intended for California native plant gardens. She constantly had an ear out for new opportunities to introduce people to the world of lichens. She also wrote articles on plant adaptations and lichens. Irene’s interactive children’s exhibit on lichens for the California Lichen Society’s annual display at the Mycological Society of San Francisco’s Fungus Fair has been so popular that it is repeated annually, as well as being presented at Cal Day at UC Berkeley’s Jepson Herbarium.

Irene’s long-standing commitment to lichens is the reason the Tilden Regional Park Botanic Garden has hosted monthly introductory lichen workshops since 2010. Her lichen interests ran much deeper than the introductory level, though; she greatly appreciated the conceptual nature of lichens, and was an admirer of Trevor Goward’s essays *Twelve Readings on the Lichen Thallus*. She also held a deep interest in the exotic chemistry of lichens. If you don’t recognize the illustration below, you can be sure Irene would have; it’s the structure of usnic acid, from an article she co-authored called “The Significance of Lichen Compounds”.

In 2014 she was awarded the California Lichen Society’s *Ramatina menziesii* Award of Excellence, which recognizes members who have given outstanding service to CALS and who are dedicated to advancing the Society’s mission. We will miss Irene and her selfless service more than we probably will realize.
California Lichen Society Grants Program

The California Lichen Society offers small grants to support research pertaining to the lichens of California. No geographical constraints are placed on grantees or their associated institutions, but grantees must be members in good standing of the California Lichen Society. The Grants Committee administers the grants program, with grants awarded to an individual only once during the duration of a project. Grant proposals should be brief and concise.

Grant Applicants should submit a proposal containing the following information:

- Title of the project, applicant’s name, address, phone number, email address, and the date submitted.
- Estimated time frame for project.
- Description of the project. Outline the purposes, objectives, hypotheses where appropriate, and methods of data collection and analysis. Highlight aspects of the work that you believe are particularly important and creative. Discuss how the project will advance knowledge of California lichens.
- Description of the final product. We ask you to submit an article to the Bulletin of the California Lichen Society, based on the results of your work.
- Budget. Summarize intended use of funds. If you received or expect to receive other grants or material support, show how these fit into the overall budget. The following list gives examples of the kinds of things for which grant funds may be used if appropriate to the objectives of the project: expendable supplies, transportation, equipment rental or purchase of inexpensive equipment, laboratory services, salaries, and living expenses. CALS does not approve grants for outright purchase of capital equipment or high-end items such as computers, software, machinery, or for clothing.
- Academic status (if any). State whether you are a graduate student or an undergraduate student. CALS grants are also available to non-students conducting research on California lichens. CALS grants are available to individuals only and will not be issued to institutions.
- Two letters of support from sponsors, academic supervisors, major professors, professional associates or colleagues should be part of your application. These should be submitted directly from the author to the committee Chair.
- Your signature, as the person performing the project and the one responsible for dispersing the funds. All of the information related to your application may be submitted electronically.

Review: Members of the Grants Committee conduct anonymous evaluation of grant proposals once a year based on completeness, technical quality, consistency with CALS goals, intended use of funds, and likelihood of completion. Grant proposals received by November 1 each year will be considered for that year’s grant cycle. The Grants Committee brings its recommendations for funding to the Board of Directors of the California Lichen Society, which has final say regarding approval or denial.

Grant Amounts: CALS typically offers two grants of $750.00 and $1000.00 each year. Typically grants are awarded to two separate individuals, however depending on the quality of the applications and the amount of funding available, the committee maintains the option to disburse funds as appropriate. All grants are partially dependent on member contributions, therefore the amounts of these awards may vary from year to year.

Obligations of recipients: 1) Acknowledge the California Lichen Society in any reports, publications, or other products resulting from the work supported by CALS. 2) Submit an article to the Bulletin of the California Lichen Society. 3) Submit any relevant rare lichen data to California Natural Diversity Data Base using NDDB’s field survey forms. See http://californialichens.org/conservation for additional information.

How to submit an application: Please email submissions or questions to the committee Chair at grants@californialichens.org by November 1 of 2021. The current Chair is Rikke Reese Næsborg.
News and Notes

**JENNIFER RYCENGA IS CALS’ NEWEST MEMBER-AT-LARGE.**

Jennifer Rycenga at the Hastings Natural History Reservation.

She was appointed during the 26th Annual Meeting (January 2020) at the UC Hastings Natural History Reserve. You may have met Jennifer at one of the annual meetings or, more likely, during a BioBlitz at one of the many San Mateo county parks. She is a strong proponent of BioBlitzes and has organized many in San Mateo county. To say that Jennifer is a lichen “enthusiast” is an understatement, as she is deeply passionate and curious about a number of taxa, including lichens, insects, and birds. In fact, she is the president of Sequoia Audubon Society, the local Audubon society for San Mateo county, and maintains their site guide for birding (http://birding.sequoia-audubon.org/). Jennifer’s affection for lichens and as she says - her “most fundamental perception of their existence” – began in October 2012 at Rancho del Oso State Park with an observation of “Spanish moss” she posted as a photograph to iNaturalist.org. Ironically, she was introduced to lichens (not uncommonly) via a plant that is neither a moss nor a lichen. It turns out that this observation (https://www.inaturalist.org/observations/140190) was soon identified as Ramalina menziesii (lace lichen), which is our California state lichen. Jennifer now has documented over 6,500 observations of lichens on iNaturalist, which continues to be the location for depositing her lichen-du-jour. CALS is fortunate to have her join the Board and share her seemingly endless passion for lichens. Welcome Jennifer!

— Reported by Julene (JJ) Johnson

**KLARA SCARNAGL HAS BEEN APPOINTED TUCKER CURATOR OF LICHENOLOGY AT UC BERKELEY**

Thanks to a generous endowment gift provided by the distinguished lichenologist and botanist Shirley Tucker, the University and Jepson Herbaria at UC Berkeley is happy to announce that Klara Scharnagl has been appointed Tucker Curator of Lichenology. Klara is currently a Postdoctoral Research Fellow in the Sainsbury Laboratory in Norwich, UK. Her arrival in Berkeley has been slightly delayed due to COVID-19 logistical barriers; she will be in residence starting in summer 2021.

Her undergraduate years were spent at the University of Chicago, where she majored in the History, Philosophy and Social Studies of Science and Medicine, and volunteered at the Field Museum of Natural History in the Botany Department, where she was exposed to lichenized fungi, the lichen symbiosis, and the tremendous
enthusiasm expressed by the graduate researchers she was working with. For her master’s thesis at Florida International University, she investigated the impact of arbuscular mycorrhizal fungi on the salinity tolerance of native and invasive legumes in the pine rockland ecosystem. For her Ph.D. at the University of Michigan, she turned back to lichens. Her doctoral dissertation focused on the latitudinal diversity gradient of lichens in the Americas.

Klara is brimming with ideas and is excited to share these with you soon! She is looking forward to leading forays and projects in urban, suburban, and wild environments.

We thank Dr. Tucker for her generosity and foresight. Her gift ensures that lichenology research will continue at the University and Jepson Herbaria and that we have the staff and resources to house and curate lichen specimens and share information about lichens with the world.

To read more about Klara and her research interests see:
https://www.symbiosiscontinuum.com/

~Reported by Brent Mishler and Klara Scharnagl
President's Message

Dear CALS members –

This issue’s conservation sponsorship on Pseudocyphellaria hawaiensis reminds me to share with you some news: the Conservation Committee is now being led by co-chairs Eric Peterson and Aaron Sims. You certainly recognize Eric’s name; he has chaired this committee since 2002. You may also recognize Aaron’s name; he is the Rare Plant Program Director for the California Native Plant Society (CNPS), and a CALS Conservation Committee member since our rare lichens became part of CNPS’s Inventory of Rare and Endangered Plants of California in 2013. Aaron worked with CALS in creating the Memorandum of Understanding between CNPS and CALS that allows our lichens to be part of the Inventory, increasing awareness and understanding of rare lichens throughout the world.

This issue also has a really interesting article on Great Basin lichens, from Jason Hollinger and Nastassja Noell. Jason also manages our membership database, and Nastassja is a former CALS grant recipient; seems that involvement in CALS promotes interest in lichens; who knew?

The CALS Board of Directors has a new member-at-large! Please join me in welcoming Jennifer Rycenga to our small family. Jennifer is remarkable: president of the Sequoia Audubon Society, passionate advocate and bioblitzor of San Mateo county parks. Check out the News & Notes section for more about Jennifer.

Alas, our annual meeting was one of many activities cancelled due to COVID-19, and we did not meet in January 2021, much to my regret. And yours, too, I’m sure. However, when the Board met at Quail Ridge in 2019, one topic that came up was whether to continue to hold this meeting the last weekend in January, when large parts of California are inaccessible. This traditional meeting time originated because it was the “birthday” of CALS’ founding at the Doell cabin in the Santa Cruz Mountains. But the Board wants to be able to hold an annual meeting in the Warner Mountains, or the Whites, or at SFSU’s Sierra Nevada Field Campus, or the Lassics, or... All higher-
elevation locations, and all closed in winter. So perhaps (late) this year we will have a get-together, and enjoy camaraderie and lichens.

The CALS Grants Program completed another successful year, awarding grants to Eli Balderas at Cal Poly to study Sulcaria isidiifera, and to Sarah Norvell at Humboldt State to inventory lichens at heavily-serpentinized Horse Mountain. Rikke Reese Næsborg will have an in-depth report in this summer’s issue.

And now a question: do you have an interest in lichens and graphic design? The Bulletin editorial staff is looking for an individual to perform the duties of production editor for the Bulletin. We need someone with an eye for detail, working to deadlines, working with authors and printers, and experience with InDesign, Scribus, or other page layout software. If you have enjoyed CALS’ activities in the past and perhaps wondered what you could do to “give back” to the community, please consider this your big chance. Contact Jes Coyle and Justin Schaffer (editor@californialichens.org).

Fingers crossed for 2021,
Tom

Tom Carlberg
President@californialichens.org
CALIFORNIA LICHEN SOCIETY

PO BOX 472, FAIRFAX, CALIFORNIA 94978

The California Lichen Society (CALS) seeks to promote the appreciation, conservation, and study of lichens. The interests of the Society include the entire western part of the continent, although the focus is on California.

Members receive the Bulletin of the California Lichen Society (print and/or online access), voter rights in society elections, access to the CALS community, and notices of meetings, field trips, lectures, and workshops.

Membership Dues (in $US per year)
Student and fixed income (online eBulletin only) - $10
Regular - $20 ($25 for foreign members)
Family - $25
Sponsor and Libraries - $35
Donor - $50
Benefactor - $100
Life Members - $500 (one time)

Membership dues can be made payable to:
California Lichen Society, PO Box 472, Fairfax, California 94978

To join or renew online, please visit www.californialichens.org/membership

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Names for the lichen species pictured on the back cover. Top left, Aspicilia americana; top right, Aspicilia fumosa. Bottom left, Aspicilia arizonica; bottom right, Aspicilia bufoides. All photos by Rachel Keuler.
Can you tell the difference?

In this issue Rachel Keuler discusses some of the challenges in identifying lichen species based on morphological traits. Here, each panel shows a different species of *Aspicilia*. The "answers" are inside the back cover...