

Bulletin  
of the  
California Lichen Society



Volume 23 No. 2 Winter 2016

# Bulletin of the California Lichen Society

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The deadline for submitting material for the Summer 2017 issue is March 1, 2017.

Volume 23(2) of the *Bulletin of the California Lichen Society* was first issued on December 21, 2016; reissued in electronic form with minor edits on January 8, 2017.

Cover image: Lace lichen illustration by Lucy Martin. [lucy@lucymartinart.com](mailto:lucy@lucymartinart.com), [www.lucymartinart.com](http://www.lucymartinart.com)

## A look at how lace lichen came to be known as *Ramalina menziesii* and how it grows its nets

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*Ramalina menziesii*, commonly known as lace lichen, is one of the most beautiful and charismatic lichens in western North America. In honor of its formal naming as the state lichen for California I would like to take this opportunity to present a brief synopsis of how this lichen came to be named *Ramalina menziesii* Taylor, as well as look at the study of the unique lace like features of its growth done by Dr. William Sanders.

### THE NAMING OF LACE LICHEN, *RAMALINA MENZIESII* TAYLOR

There are several documented uses of lace lichen by the indigenous tribes of what is now known as California. The Kawaiisu people used it for its magical properties, placing this lichen in water would bring rain and placing it in fire repelled thunder and lightning. The Kawaiisu word for lace lichen is paaziomóora (Zigmond 1977). The Kashaya Pomo people of northern California used this lichen as sanitary material (as cited in Sharnoff 2003). The names used by California's first inhabitants are the earliest known human names used to distinguish this lichen.

The distinctive morphology and extensive biomass of lace lichen has generated interest among lichenologists for quite some time. In 1872 the English common name was already in use and Edward Tuckerman wrote that lace lichen was: "one of the most remarkable of the species characteristic of the West Coast where it is most abundant" (Tuckerman 1872).

Lace lichen was first given a Linnean binomial name in 1775 by the pioneering botanist Archibald Menzies, the naturalist on Vancouver's *Discovery* expedition. His herbarium notes referred to it as *Lichen retiformis*. It is one of 11 lichens discovered by Menzies on his trip to coastal western North America (Galloway 1995), although this name was not published until

1848. In the meantime, *Lichen reticulatis* was the name applied to this lichen by Nöhden in 1801 based on material from the "northwest coast of America" (Howe 1914). In 1847 in his work describing new lichens based on the herbarium of Sir William J. Hooker, Thomas Taylor incorporated lace lichen into the genus *Ramalina* Ach. He named the species *Menziesii* giving it the name and authority that is still in use today.

In 1848 Tuckerman briefly referred to it as the older name *Ramalina retiformis* in his paper "A synopsis of the lichens of New England, the other Northern states, and British America" before settling on the name *Ramalina menziesii* in the 1855 exsiccati "Lichenes Americae septentrionalis exsiccati. Fasc. I-VI, 150 nrs.". Type specimens from the Tuckerman herbarium were collected in Monterey, CA. Photographs of the type material can be found in Howe (1914).

The oldest pictured collection of *R. menziesii* from California that turned up in an online search of herbaria (CNALH 2016) is housed at the Farlow Herbarium (F) at Harvard University and is a collection made from an unnamed location in California sometime around 1846 by John C. Frémont on his third expedition into California (Figure 1).

### HOW DOES LACE GROW? AN INTERVIEW WITH DR. WILLIAM SANDERS

After lace lichen was designated the state lichen for California I began to wonder what work had been done on this lichen in the state. It turns out that this lichen has an extensive history of study in California, and I ran across a fascinating series of papers by William Sanders describing the growth patterns of *Ramalina menziesii* from California material. I decided to sit down at the computer and ask a few questions of Dr. Sanders for the enjoyment of the readers of the *Bulletin*.



Figure 1. Oldest photographed collection of *Ramalina menziesii* from California represented in the Consortium of North American Lichen Herbaria (CNALH). J. C. Frémont collected this specimen around 1846 when California was still a part of Mexico.

**JV:** I am fascinated by your papers describing in great detail the development of the characteristic reticulate growth pattern of the nets in lace lichen. You characterize how the nets basically unroll from the growing end of the very small net buds, at that point the perforations are apparent and the net then begins to expand while those individual perforations remain, only to grow larger as the thallus expands. Do you think there is seasonality to this net bud production? Is the pattern of the thallus basically unrolling from the growing area, observed in other fruticose lichens?

**WS:** Formation of the net buds (Figure 2) and production of the new perforate tissue at the inrolled apex, is surely linked to favorable growth conditions. In coastal California, rainfall is mainly limited to winter, but for lichens the picture may be more complicated. Fog is considered to be a very important source of moisture for the lace lichen, so the growth patterns may not coincide so strictly with rainfall. The published work of Virginia Boucher and colleagues (Nash, Larson, etc.) in the 80's and 90's examined some seasonal aspects of growth and biomass accumulation in different populations of *R. menziesii*, although their focus was not on morphological development.

What I found in *R. menziesii* was that the inrolled apex was the site of morphogenesis; in other words, the formation of new reticulations from perforated tissue occurred only at these apical zones (Figure 3). As with a plant shoot apex, where only at the apical meristem are new leaves formed on the stem. However, unlike plant shoots, growth of the perforated tissue in *R. menziesii* occurs over the entire net, so the net can keep getting larger, even though new reticulation will form from perforated tissue only at the inrolled apical margin (Figure 4).

It's hard to compare this to other fruticose lichens, since the morphogenetic pattern of net formation is fairly unique to this lichen. A number of other lichens have inrolled apical margins, including many/most *Ramalina* species. In *Teloschistes flavicans*, the cilia are formed centrally on an inrolled margin and this result in the forking of the growing tip.



**JV:** One of the most intriguing aspects of lichen fieldwork for me is the concept that by looking closely at the lichen flora of a given area one can draw inferences about the environmental conditions of that exact place. For instance by knowing the presence and abundance of various lichen species one can draw conclusions about the historic conditions of the stand, giving one a sense of the ecological continuity. In other words, lichen community composition has an indicator value. Given your work on thallus development in lace lichen do you think it is possible to look closely at the individual thalli present at a given site and get a sense of the “history” of that spot? For instance could you detect a particularly damaging wind event that happened last year by looking at the patterns of growth or production of net buds/daughter nets? This makes me wonder if the coastal form is morphologically different because it is subject to more

intense winds, the nets break up and can’t survive to be as big. What do you think?

**WS:** These are interesting questions that I can’t provide much of an answer to. There’s no question in my mind that the nets at the coast break up more readily, and that this is fundamental to the difference in the developmental pattern between coastal and inland forms (Figure 5). The reticulate tissue formed at the apex in coastal populations is often much more delicate; you can see this in the images in my second paper on *R. menziesii* (Sanders 1992). But I do not know of any work that has yet distinguished between environmental versus genetic differences as responsible, although we now have the molecular tools to see whether “coastal” versus “inland” morphs reflect genetic differences. That would be a great PhD project for someone.

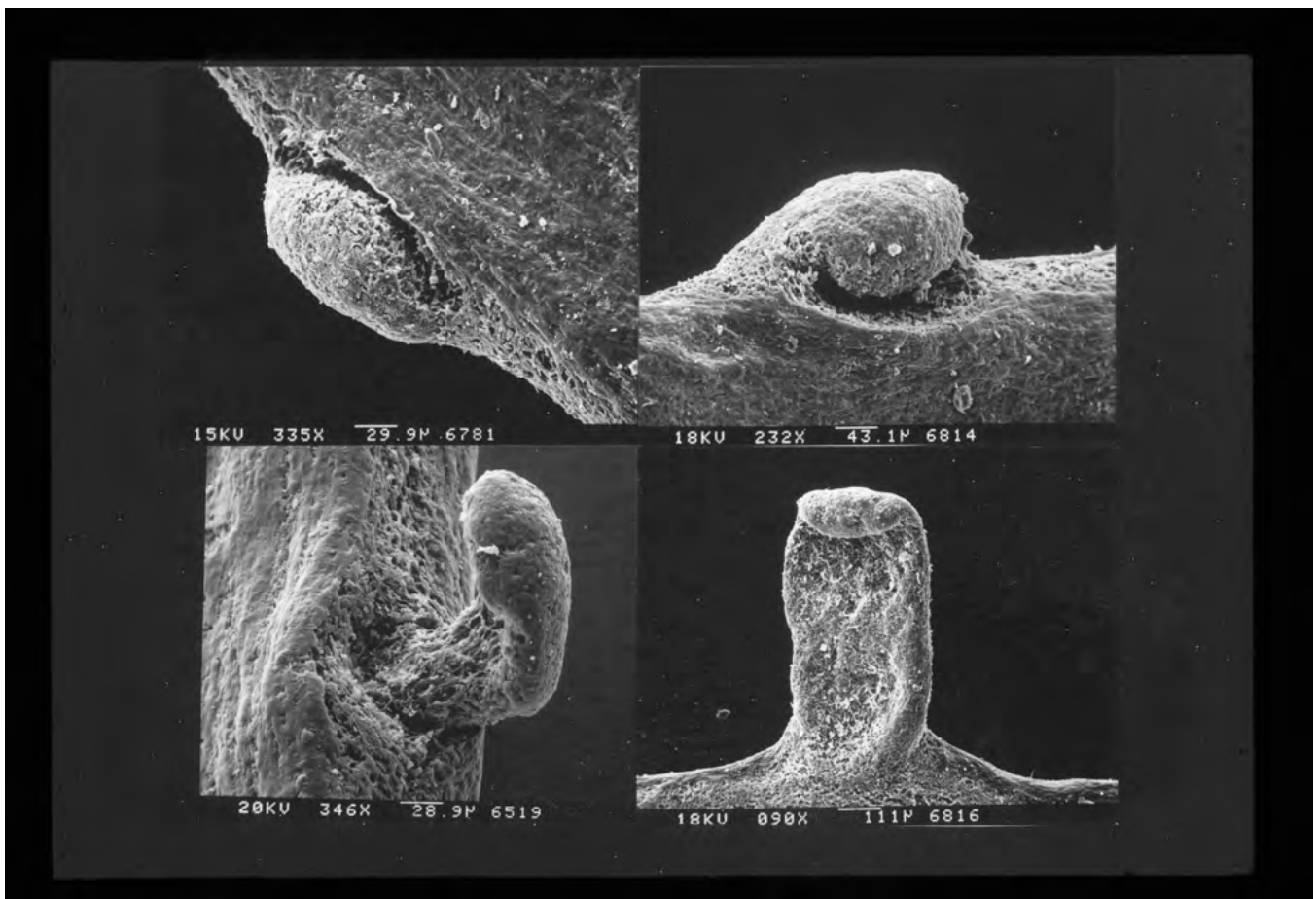
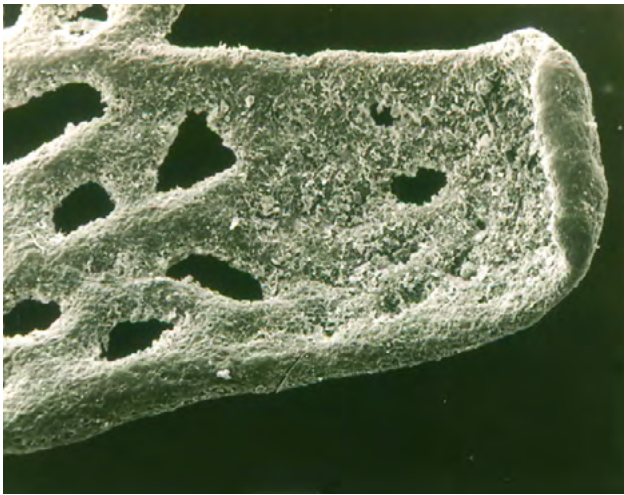


Figure 2. The stages of net bud formation in *Ramalina menziesii*.

WILLIAM SANDERS



WILLIAM SANDERS

Figure 3. Apical zone of net with perforations beginning to form.



WILLIAM SANDERS

Figure 4. The in rolled margin and developing net of *Ramalina menziesii*.



WILLIAM SANDERS

Figure 5. Net displaying damage of reticulated tissue.

**JV:** Describe a specific place in California where you encountered a noteworthy population of lace lichen. Why was this a special place for lace lichen?

**WS:** Santa Cruz Island had a population of lace lichen that didn't seem to fit the coastal/inland paradigm of morphology gradient, but I did not do any more than write a little note about it in the *Bulletin of the California Lichen Society* (1997). One of the hardest things in the Larson-Nash-Boucher studies that dealt with morphology of this lichen was their great difficulty in characterizing the morphological differences with any simple morphometric index. So it's still hard to describe exactly how the different populations of this lichen differ morphologically. I limited myself (in the 1992 paper) to merely describing the morphogenetic differences visible at the apical margin.

#### LITERATURE CITED

- Galloway, D.J. 1995. The extra-European lichen collections of Archibald Menzies MD. *FLS* (1754–1842). *Edinburgh Journal of Botany*, 52, pp 95-139.
- Howe, R. H. 1914. "North American Species of the Genus *Ramalina*. Part IV". *The Bryologist* 17 (2). 17–27.
- Sanders, W.B. 1989: Growth and development of the reticulate thallus in the lichen *Ramalina menziesii*. - *American Journal of Botany* 76(5): 666-678.
- Sanders, W.B. 1992: Comparative in situ studies of thallus net development in morphologically distinct populations of the lichen *Ramalina menziesii*. - *The Bryologist* 95(2): 192-204.
- Sanders, W.B. 1997: Thallus form in *Ramalina menziesii* and its variants on Santa Cruz Island (Santa Barbara Co., California). - *Bulletin of the California Lichen Society* 4(2): 24-26.
- Sanders, W.B., and C. Ascaso. 1995: Reiterative production and deformation of cell walls in expanding thallus nets of the lichen *Ramalina menziesii* (Lecanorales, Ascomycetes). - *American Journal of Botany* 82(11): 1358-1366.

Sharnoff S. D. 2003: Bibliographical database of the human use of lichens. <http://www.lichen.com/usetaxon.html>

Weber, W.A. 1970: The names of two common Californian *Ramalina* species. - *Taxon* 19: 253-254.

Zigmond, Maurice L., 1977, The Supernatural World of the Kawaiisu in Thomas C. Blackburn (ed.) *Flowers of the Wind: Papers on Ritual, Myth, and Symbolism in California and the Southwest*. Socorro: Ballena. (Northamerican Indians in the U. S. Southwest.) pp. 59 - 95.



SHELLY BENSON

Intricate nets of lace lichen (*Ramalina menziesii*) at an inland location; Olompali State Historic Park, Sonoma County, California.



## Some results of Dr. Silke Werth's study of lace lichen

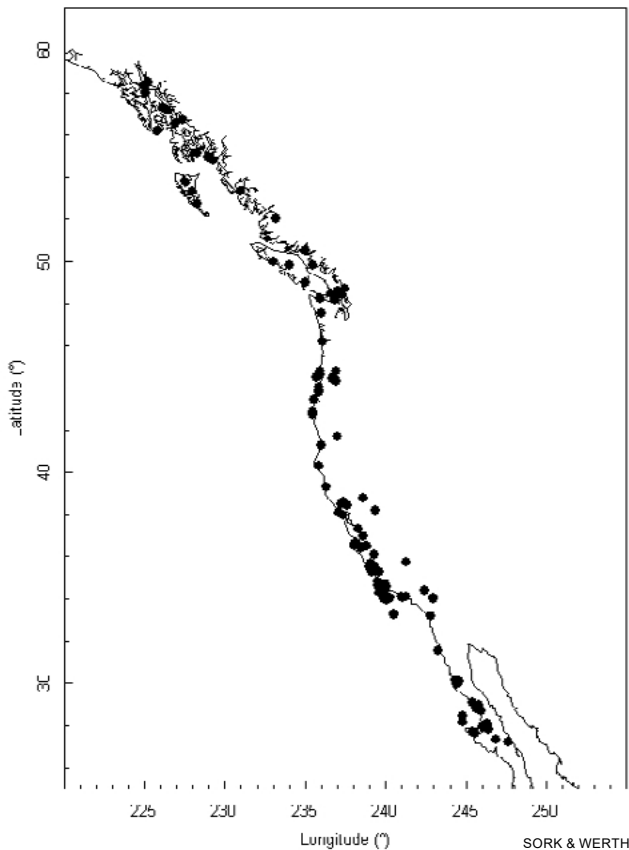
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Molecular biologist and lichenologist Dr. Silke Werth studied lace lichen in the first decades of the 21<sup>st</sup> century, collecting it from the foggy coastal deserts of Baja California to Alaska. She is an author of six papers on *Ramalina menziesii* (see cited literature below). In this article I present some of the results of her studies for incorporation in teaching materials on the lace lichen. I risk over-simplification of her award-winning scientific work. Her papers on the lace lichen are excellent examples of the current study of lichenized fungi and their photobionts. They are worthwhile reading for the specialist and student as well as the curious.

1. From Baja California and Alaska, lace lichen was found in six distinct ecoregions: Baja California, coastal chaparral, inland southern California, inland north California, coastal California, and Pacific Northwest (for explanations and maps see Sork & Werth 2014). For her studies Dr. Werth collected in all of these ecoregions and specimens were sequenced from all ecoregions for her studies. Members of the California Lichen Society aided Dr. Werth by sending her samples and distributional data. Throughout her studies, Dr. Werth worked closely with Dr. Victoria Sork of UCLA.



Distribution map of *Ramalina menziesii* along the western coast of North America.



Lace lichen (*Ramalina menziesii*) at Sedgwick Reserve, Santa Ynez, California.



2. Lace lichen probably originated in ancient southern or Baja California. But it did not migrate from a single location. Its current widespread distribution and its stability as a species as well as its genetic structure reveal the complex origin of its modern distribution. At different times populations of lace lichens have been isolated from each other. But also there have been migrations and intermixing of populations. For instance inland California populations have experienced repeated migrations of coastal populations. Lace lichen has travelled back and forth between the Channel Islands and Santa Monica Mountains.
3. While some coastal populations seem to rarely have apothecia and replicate by fragmentation (asexual reproduction), most populations are primarily reproducing sexually and apothecia are relatively common.
4. Lace lichen switches strains of the green algal photobionts *Trebouxia decolorens* and *T. jamesii*. These algal strains have evolved in different climates and on different trees and shrubs in the ecoregions where lace lichen occurs. Switching strains of photobionts allows lace lichen the flexibility to occur on a wide variety of trees and shrubs in six different ecoregions.
5. At Sedgwick UC Reserve lace lichen occurs on three oak species. It shares *Trebouxia decolorens* with seven other members of the lichen community on oaks, *Xanthoria hasseana* & *X. tenax*, *Physcia adscendens*, and species of *Ramalina*.
6. Lace lichen ascospores usually germinate on areas of bark where a community of macrolichens is already growing. The community probably creates a microclimate that favors the germination and early growth of the lace lichen. There was no molecular evidence lace lichen steals its photobiont from its neighbors despite this close association with mature lichen communities on bark and wood.



SILKE WERTH



SILKE WERTH

Lace lichen in the Baja California desert (above) and in California oak woodlands (below).

These are some results of Dr. Werth's research on lichen. In teaching materials, Dr. Werth can be used as an example of women working in science too. I have known Silke for over 10 years. Since I first read her doctoral thesis, I have been impressed by the persistent brilliance of her mind. From the first time we went hiking in Santa Monica Mountains I was impressed by her curiosity. As with all biologists, when they are working with their model organism, it is a pleasure to see Silke in the field excited about lichen draping an island scrub oak. She is truly an international scientist. A German she got her doctorate studying *Lobaria* in Fennoscandia and has worked in California, Iceland, and Switzerland. She currently teaches at Karl-Franzens-Universität Graz, in Austria. Her dedication to her students is exemplary. She has published over 30 scientific papers. She is a good cook. She loves photography. I remember her on Santa Rosa Island, after a long day exploring elfin woods, reading Harry Potter.



Dr. Silke Werth

#### LITERATURE CITED

- Chen, J.-M., S. Werth & V.L. Sork. 2016. Comparison of phylogeographical structures of a lichen-forming fungus and its green algal photobiont in western North America. *Journal of Biogeography* 10.1111/jbi.12697.
- Sork, V. L. & S. Werth. 2014. Phylogeography of *Ramalina menziesii*, a widely distributed lichen-forming fungus in western North America. *Molecular Ecology* 23(9): 2326–2339.
- Werth, S. 2012. Fungal-algal interactions in *Ramalina menziesii* and its associated epiphytic lichen community. *Lichenologist* 44(4): 543–560.
- Werth, S. & V. L. Sork. 2008. Local genetic structure in a North American epiphytic lichen, *Ramalina menziesii* (Ramalinaceae). *American Journal of Botany* 95(5): 568–576.
- Werth, S. & V. L. Sork. 2010. Identity and genetic structure of photobiont of the epiphytic lichen *Ramalina menziesii* on three oak species in Southern California. *American Journal of Botany* 97(5): 821–830.
- Werth, S. & V. L. Sork. 2014. Ecological Specialization in *Trebouxia* (Trebouxiophyceae) Photobionts of *Ramalina menziesii* (Ramalinaceae) across Six Range-Covering Ecoregions in Western North America. *American Journal of Botany* 101(7): 1127–1140.

## The significance of lichen compounds

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Since 2011, Bill Hill and Irene Winston have offered regularly occurring lichen workshops at the Regional Parks Botanic Garden in Berkeley, California. The free workshops are held on the second Saturday of the month and are open to all who are interested. It is a perfect setting to learn about lichens because it provides incredible habitat. The 10-acre garden is planted with California native vascular plants. As a garden docent, Irene prepared materials for self-guided lichen walks where visitors can observe lichens easily from the garden's pathways. The lichens included in this article were chosen with that in mind.

What is a lichen? It is a complex ecosystem composed of a fungus, a photosynthesizing partner (a green alga and/or a cyanobacterium), and non-photosynthetic bacteria. It was recently discovered that many lichens also contain basidiomycete yeasts (Spribille et al. 2016). Lichens serve a number of ecological functions including: habitat, nesting material, forage, nutrient cycling, and soil creation and stabilization. One interesting aspect of lichens that is often glossed over is their function as tiny chemical factories.

Lichens produce a plethora of different chemical compounds. These can be divided into two main groups—primary metabolites and secondary metabolites. Primary metabolites are produced and reside inside the cells of the fungus and photosynthesizing partner. Examples include amino acids, proteins, vitamins, and polysaccharides. Most of these organic compounds are not unique to lichens—they also occur in free-living algae, fungi, and plants.

Secondary metabolites are produced only by the fungus and are deposited on the outer surface of the fungal hyphae. Lichens produce over 800 secondary metabolites, most of which are not found elsewhere in nature (Kowalski et al. 2011). Many of these compounds are chemically identified as acids and the

term 'lichen acids' is often used interchangeably with secondary metabolites. The major categories (classes) of lichen secondary metabolites are: anthraquinones, phenols, depsides, depsidones, and triterpenes.

Some secondary metabolites provide ecological benefits for lichens. For instance, many lichens growing on exposed substrates produce light-absorbing compounds in their upper cortex. These compounds effectively screen out a portion of incoming light from reaching the algal layer. This is helpful for *Trebouxia*, a common green algal photobiont, because it grows best at low light intensity (Elix 1996). Lichens in the genus *Letharia* are bright yellow due to the presence of the light-absorbing compound called vulpinic acid. In addition to filtering light, vulpinic acid is poisonous to many mammals, insects, and mollusks, thereby protecting the lichen from herbivory.

Many lichen secondary metabolites have antioxidant, allelopathic, antimicrobial, insecticidal, cytotoxic, antitumor, antiviral, antipyretic, and/or analgesic properties (Molnar and Farkas 2010). With such a wealth of special compounds lichens could be a new source of important chemicals to which harmful bacteria or insects, for example, have not yet developed resistance. Researchers continue to study lichen secondary metabolites and test their efficacy as medicines and naturally derived pesticides.

Historically, throughout the world, especially in temperate and arctic regions, lichens have been recognized as sources of traditional medicines (Crawford 2014). Certain species were used as external disinfectant for dressing wounds, stopping bleeding, and healing skin infections and sores. Lichens were also used as internal medicine for lung and digestive ailments, and for obstetrical ailments. Early Chinese and Egyptian civilizations used lichens as raw sources



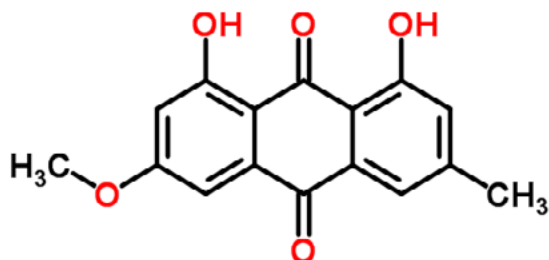
for perfumes, cosmetics, and medicines. Lichens were also used in Egyptian mummifications. What an extraordinary value of lichens' secondary metabolites chemistry.

Penicillin was derived from the *Penicillium notatum* fungus that in its evolutionary past had been a lichenized fungus that “delichenized,” or separated from its photobiont. In this case, a lichenized fungus that moved away from its symbiotic state still retains all the special secondary compounds that were produced during the previous lichenized state (Lutzoni, et al. 2001).

The following are examples of common lichen acids: parietin, usnic acid, atranorin, and lecanoric acid. These are the main secondary metabolites in the following lichen genera found at the garden: *Xanthoria*, *Usnea*, *Physcia*, and *Lecanora*, respectively. The properties of these common secondary metabolites are discussed below.

### PARIETIN $C_{16}H_{12}O_5$

Class of secondary metabolite: anthraquinones

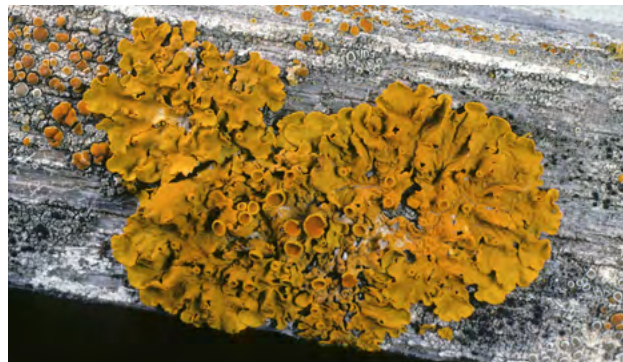


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Chemical structure of parietin.

Parietin is an orange pigment found in the cortex of many genera within the family Teloschistaceae, including: *Teloschistes*, *Caloplaca*, *Xanthoria*, and *Xanthomendoza*. It reflects orange light (what we see) and absorbs the compliment color, blue light. Lichen algae are relatively sensitive to blue light which can cause damage to their cells. Parietin in the upper cortex effectively protects algal cells by reducing the amount of blue light that reaches the algal layer. When *Xanthoria*, for example, grows in exposed areas with lots of sunlight it produces more parietin to filter out more blue light. *Xanthoria*

growing in shaded microhabitats doesn't need so much photobiont protection and the lichen produces less parietin—resulting in a lighter orange color of the thallus.



STEPHEN SHARNOFF

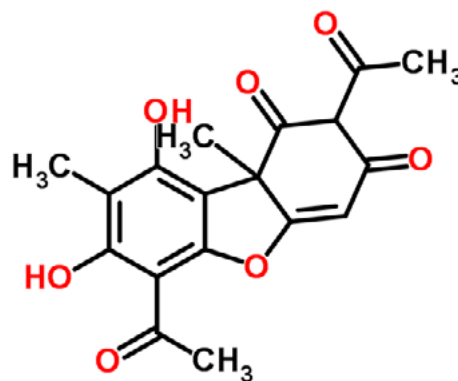


NORBERT NAGEL CC-BY-SA-3.0

*Xanthoria parietina*—sun-exposed specimens (above) are bright orange because they produce a lot of the photo-protective pigment called parietin, while shade-grown specimens (below) are more greenish because they produce less parietin.

### USNIC ACID $C_{18}H_{16}O_7$

Class of secondary metabolite: usnic acids



CHEMSPIDER

Chemical structure of usnic acid.

Usnic acid is a yellow, light-absorbing compound found in the cortex of many lichen genera including: *Usnea*, *Ramalina*, *Evernia*, *Flavoparmelia*, and *Flavopunctelia*. Usnic acid is responsible for the characteristic yellow-green color of these genera. This color is also called usnic yellow in some lichen identification guides.

Chemical spot tests are used as a tool to determine the presence or absence of specific lichen compounds. Usually, a spot test is not needed to determine the presence of usnic acid—you can tell just by looking for the characteristic yellow-green color. However, the spot test used for usnic acid is KC and if present, the reaction is yellow-orange.

The bitter flavor of usnic acid may deter animals or insects from eating lichens containing the



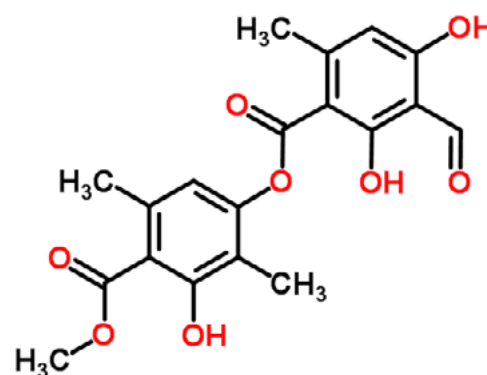
STEPHEN SHARNOFF

*Usnea intermedia* displaying the typical usnic yellow coloring often observed in this genus, as well as in species of *Ramalina*, *Evernia*, and *Flavopunctelia*.

compound. It has been used in medicine, perfumery, and cosmetics. It shows antibiotic properties against Gram-positive bacteria such as *Staphylococcus*, *Streptococcus*, *Pneumococcus*, *Mycobacterium tuberculosis* and some pathogenic fungi. In northern Europe usnic acid is a component of antibiotic creams. It also has antiviral, antiprotozoal, antimitotic, anti-inflammatory, and analgesic effects (Molnar and Farkas. 2010).

### ATRANORIN C<sub>19</sub>H<sub>18</sub>O<sub>8</sub>

Class of secondary metabolite: depsides



CHEMSPIDER

Chemical structure of atranorin.

Atranorin, like parietin and usnic acid, resides in the lichen upper cortex and functions as a sunscreen that protects the algal layer from damaging UV radiation. Atranorin differs in that it is a colorless compound and many atranorin-containing lichens are white or light gray in color. Since you can't see atranorin, the K spot test is used to detect this compound in lichens—a positive reaction is yellow. The genus *Physcia* is characterized by the presence of atranorin and several species are common at the garden.

Atranorin acts as an antioxidant; that is, it helps cells under oxidative stress. The negative side effects of free radicals (reactive oxygen species) cause breakdown of proteins and nucleic acids and unsaturated fatty acids in cell membranes. Human diseases such as Alzheimer's, atherosclerosis, emphysema, hemochromatosis, Parkinson's, and schizophrenia result from oxidative damage. Imagine obtaining new chemicals, natural antioxidants, from lichens to treat these conditions.



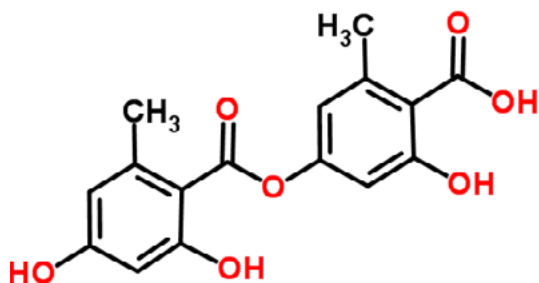


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*Physcia adscendens*, a common lichen that contains the colorless compound atranorin in the cortex.

### LECANORIC ACID $C_{16}H_{14}O_7$

Class of secondary metabolite: depsides



CHEMSPIDER

Chemical structure of lecanoric acid.

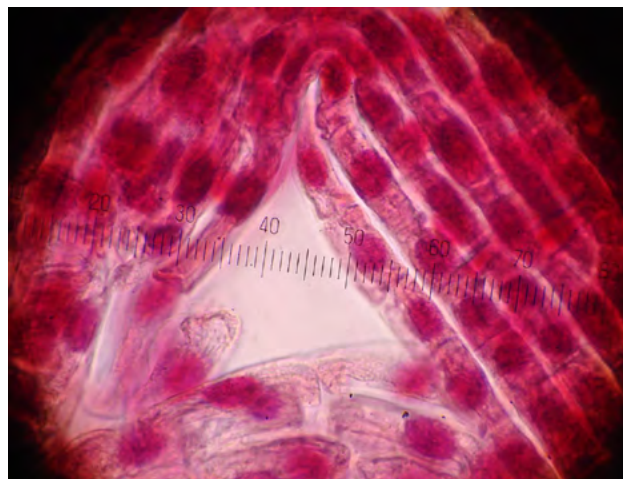
Similar to atranorin, lecanoric acid has antioxidative properties. It also is one of the lichen acids that is a dye precursor; under the right conditions, this acid will produce the red or purple dyes historically used to color textiles. Though the practice of producing purple large quantities of purple dye from lichens is not sustainable—particularly from crustose species—it is still interesting to understand how a color like purple emerges from white, gray, or light green lichen.

In the presence of ammonia and oxygen, the colorless lecanoric acid transforms into purple molecules of orcein (see molecular diagram below).  $\alpha$ -hydroxy-orcein is one of the natural orcein compounds that can be found in orcein-dyed silk (Melo et al. 2016). The purple dye has also been used as a stain in microscopy and is very similar to litmus, another dye sourced from

lichens. These brightly-colored pH-sensitive dyes can be useful, but they are also just fascinating to observe during their seemingly magical transformation from a greyish-green lichen to a bright purple color-changing dye. Lecanoric acid is just one of the lichen acids that acts as a dye precursor.



STEPHEN SHARNOFF



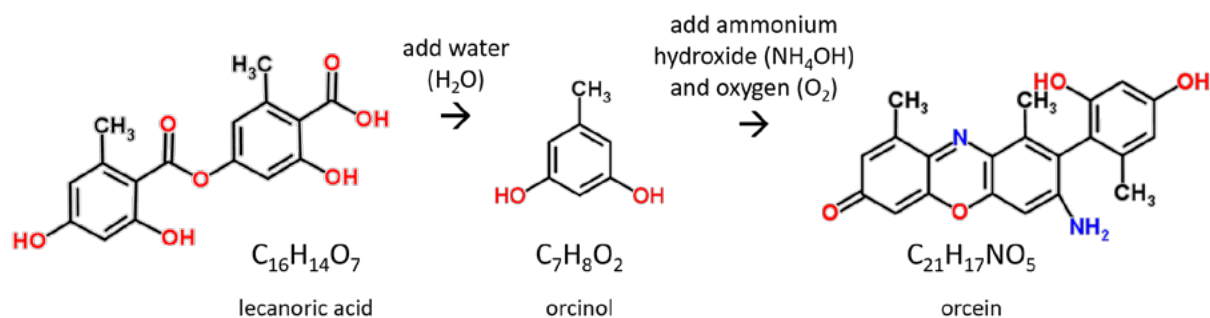
MARSHLIGHT (CC BY-NC-ND 2.0)

Above: Lichens in the genus *Lecanora* contain lecanoric acid. A common representative at the garden is *Lecanora muralis*. Below: Onion root tip cells stained with the lecanoric acid derived aceto-orcein stain.

### THE FUTURE OF LICHEN COMPOUNDS

Given the interesting array of lichen compounds and their potential benefit, we look forward to hearing more about lichen research and discovery. The importance of the fascinating chemical compounds produced by lichens encourages us to protect and conserve the planet's biodiversity.





Formation of purple orcein molecules from lecanoric acid; process adapted from equations in Upreti et al. (2015).

### LITERATURE CITED

- Crawford, S.D. 2014. Lichens Used in Traditional Medicine, in *Lichen Secondary Metabolites: Bioactive Properties and Pharmaceutical Potential*, Branislav Rankovic, ed. Ch. 2.
- Elix, J.A. 1996. Biochemistry and secondary metabolites. In T.H. Nash (Ed.), *Lichen Biology* (CH 9 pp154-180). New York, NY, Cambridge University Press.
- Kowalski, M., G. Hausner, and M.D. Piercey-Normore. 2011. Bioactivity of secondary metabolites and thallus extracts from lichen fungi. *Mycoscience* 52:413-418. DOI 10.1007/s10267-011-0118-3
- Lutzoni, F., M. Pagel, and V. Reeb. 2001. Major fungal lineages are derived from lichen symbiotic ancestors. *Nature* 411:937-940.
- Melo, M.J., Nabais, P., Guimarães, M., Araújo, R., Castro, R., Oliveira, M.C. and Whitworth, I., 2016. Organic dyes in illuminated manuscripts: a unique cultural and historic record. *Phil. Trans. R. Soc. A*, 374(2082), p.20160050.
- Molnar, K. and E. Farkas. 2010. *Current Results on Biological Activities of Lichen Secondary Metabolites: A Review*. Verlag der Zeitschrift für Naturforschung, Tübingen .pp. 157- 173. <http://www.znaturforsch.com>
- Spribile, T., V. Tuovinen, P. Resl, D. Vanderpook, H. Wolinski, M.C. Aime, K. Schneider, E. Stabentheiner, M. Toome-Heller, G. Thor, H. Mayrhofer, H. Johannesson, and J.P. McCutcheon. 2016. Basidiomycete yeasts in the cortex of ascomycete macrolichens. *Science* published online July 21, 2016. doi: 10.1126/science.aaf8287.
- Upreti, D.K., Divakar, P.K., Shukla, V. and Bajpai, R. eds., 2015. *Recent Advances in Lichenology: Modern Methods and Approaches in Lichen Systematics and Culture Techniques* (Vol. 2). Springer.

## A name misapplied: *Tornabea scutellifera* does not occur in North America

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### ABSTRACT

*Tornabea scutellifera* does not occur in California, Baja California (Mexico), or North America. The reports were based on the misidentification of sterile, poorly developed specimens of *Seiophora californica* (syn. *Teloschistes californicus*) with thin depauperate to normal young branches without soredia, apothecia, or pycnidia, often coated with sand and hairless. Most of the specimens appeared damaged, both sand blasted by storms as well as suffering from parasites.

### DISCUSSION

*Seiophora californica* (Sipman) Frödén (synonym *Teloschistes californicus*) is a conspicuous lichen most people will never see in California unless they take a day trip to Santa Barbara Island. It grows tangled in the branches of coastal shrubs. It is a sub-fruticose lichen. In the beginning, slender branches emerge from a holdfast, often twining, the tips dividing in several directions. These branches thicken and eventually widen horizontally, flattening out into blades, becoming perforated and usually densely hairy, fringed with adventitious hyphae like fine tentacles (called fibrils). The lower cortex is very thin or absent. The thallus eventually splits open and spills out green soredia. Rarely are there orange apothecia or orange-tipped pycnidia. But in its mature sorediate form it is unmistakable and easily identified with a hand-lens. There is a good picture of *Seiophora californica* in Volume 2 of the *Lichen Flora of the Greater Sonoran Desert Region* as *Teloschistes californicus*, a synonym (Nash et al. 2004). Be aware that *Seiophora californica*, unlike the specimen in the flora's picture, usually does not have apothecia and pycnidia but produces greenish soredia. Sharnoff (2014) shows a typical mature sterile thallus with a grayer and duller color, more how it looks in the field on an overcast day on Santa Barbara Island.

*Seiophora californica* is endemic to the Pacific Plate Lichen Bioregion, a biota which stretches from the tip of Baja California to Point Reyes north of San Francisco, with possibly 50 endemic species of lichenized fungi and lichenicolous fungi (Knudsen et al. 2014; Knudsen & Kocourková 2012). In California, *Seiophora californica* is scattered on Santa Barbara, San Miguel, San Nicolas, and Santa Rosa Islands, growing tangled in the small branches of coastal shrubs like *Artemisia* and *Eriogonum* in dry sunny open spaces. It is relatively rare and has not



STEPHEN SHARNOFF

*Seiophora californica* (synonym *Teloschistes californicus*), Santa Rosa Island, Channel Islands, California.



been reported from the other four southern California islands (Anacapa, Catalina, San Clemente, and Santa Cruz). It also occurs along the coast of Baja California in Mexico. The botanist and professional collector of cacti and mollusks C.W. Orcutt made the oldest known collection in the 19<sup>th</sup> century along San Quintin Bay in Baja (SBBG!). Botanical explorer Blanche Trask collected it on San Nicolas Island in the early 20<sup>th</sup> century. The pioneer California lichenologist H.E. Hasse reported it from California near Newport Beach in Orange County and from Point Loma in San Diego (Hasse 1913). There are no currently known populations along the south coast of California in Orange or San Diego Counties where Hasse collected it. *Seiophora californica* was known to the early lichenologists as *Teloschistes villosus* (Ach.) Norman (Hasse 1913). Eventually the great German and international lichenologist H. Sipman described the California taxon as the new species *Teloschistes californicus* (Sipman 1993) and

*Teloschistes villosus* was no longer recognized as occurring in California and Baja California. In 2004, *Teloschistes californicus* was transferred to a new genus and became *Seiophora californica* (Frödén & Lassen 2004).

In the *Lichen Flora of the Greater Sonoran Desert Region*, *Tornabea scutellifera* (With.) J.R. Laundon was reported for the first and only time from the southern California islands, Baja California, and North America (Nimis & Tretiach 2002). This species occurs in Europe and the Middle East, as well as the Canary Islands and on the coast of Chile in South America (where the taxon has been considered a separate species of *Tornabea*). It is a distinctive lichen. Google it and you can see many good images of *Tornabea*. It is more robust than *Seiophora californica* with a thicker lower cortex, brown pycnidia, and often is covered with apothecia with dark brown 1-septate ascospores (Nimis & Tretiach



JANA KOCOURKOVÁ

Typical *Seiophora californica* habitat on Santa Barbara Island.



2002). Superficially sterile and immature specimens can look like *Seiropora californica*.

During fieldwork, we were not able to find any populations of *Tornabea scutellifera* on the Channel Islands, especially in Bee Canyon on Santa Rosa Island, from where it was originally reported (Knudsen & Kocourková 2012). Looking for clues on where to find it, we re-examined the records in the Consortium of North American Lichen Herbaria (CNALH 2015), including cross-checking collection numbers. The collection *Nash 32715* was listed three times in CNALH, twice as *Teloschistes californicus* and once as *Tornabea scutellifera*. Apparently *Tornabea scutellifera* had been misidentified. We had to check all specimens still identified as *Tornabea* from the Sonoran region.

On Santa Rosa Island, in Bee Canyon on the south side, on Jan. 2, 1994, Pier Luigi Nimis, Mauro Tretiach, Cherie Bratt, Janet Marsh, Clifford Wetmore, Thomas Nash, Steve Sharnoff, and Bruce Ryan collected specimens they identified as sterile *Tornabea scutellifera*. The specimens identified as *Tornabea* were not checked by a taxonomic expert in *Teloschistaceae* before the publication of Vol. 1 of the *Lichen Flora of the Greater Sonoran Desert Region* and *Tornabea scutellifera* was reported new for North America and California (Nimis & Tretiach 2002). Later Swedish taxonomist P. Frödén, in preparing the treatment on *Teloschistes* for Volume 2 of the flora, examined most of the specimens from that day of collecting in Bee Canyon and re-annotated them as *Teloschistes californicus*. But he did not see from that day in Bee Canyon one Janet Marsh collection (*Marsh 6741*, ASU!), one Thomas Nash collection (*Nash 32715*, ASU!), and one Clifford Wetmore collection (*Wetmore 73683*, MIN!). They were still identified as *Tornabea scutellifera* in the database of the Consortium of North American Lichen Herbaria (CNALH 2015).

We examined all three specimens from North American herbaria. All were *Seiropora californica*. They were young with many thin and almost hairless branches, no mature blades, no apothecia or pycnidia, and no soredia. The specimens all had a much thinner cortex and lighter color than *Tornabea*. Nonetheless

we had never seen such depauperate specimens of *Seiropora californica* on the islands. The collections showed signs of sand blasting (with sand crystals still stuck to the cortex) and the population had obviously been damaged in a storm. More interesting was a sign of a possible infection which suggested all the specimens were also parasitized by an undescribed fungal parasite that had prevented a full development of thallus.

To complete this study, in Trieste, Italy at the TBS Herbarium, we examined three collections of *Tornabea scutellifera* by Nimis and Tretiach from the Pacific Plate Lichen Bioregion and not seen by P. Frödén. Two specimens were from Bee Canyon on Santa Rosa Island (*Nimis & Tretiach 18376 & 18377*, TBS!). They were both better specimens than the other collections we examined but still had no soredia, apothecia, or pycnidia. The branches were generally narrow. These specimens appeared mainly infected by the lichenicolous fungus *Sphaerellothecium subtile* Triebel & Rambold. Like other specimens they had a thinner cortex and lighter color than *Tornabea*. The other specimen collected by Nimis and Tretiach (*Nimis & Tretiach 24501*, TBS!) was collected near Rosario along Highway 1 in Baja California in 1993 and it is annotated “*Tornabea?*” It is a single branch of *S. californica* without pycnidia, soredia, or apothecia and apparently uninfected by parasites. The two dots in distribution map of Vol. 1 of Sonoran flora represent these three collections (Nimis & Tretiach 2002).

With all known collections from the Pacific Plate Lichen Bioregion identified as *Tornabea* examined by either P. Frödén or ourselves, *Tornabea scutellifera* is no longer recognized as occurring in North America.

#### ACKNOWLEDGMENTS

We thank the curators of ASU, MIN, SBBG, TBS and UCR for specimens of *Seiropora californica* and *Tornabea scutellifera*. The work of Kerry Knudsen and Jana Kocourková was financially supported by the grant “Environmental aspects of sustainable development of society” 42900/1312/3166 from the Faculty of Environmental Sciences, Czech University of Life Sciences Prague.

**LITERATURE CITED**

CNALH. <http://lichenportal.org/portal/> Accessed June and July. 2015.

Frödén, P and P. Lassen, P. 2004. Typification and emendation of *Seiophora* Poelt to include species segregated from *Teloschistes* Norman. Lichenologist 36(5): 289–298.

Hasse, H.E. 1913. The lichen flora of southern California. Contributions from the United States National Herbarium, 17: 1–132.

Knudsen, K. and J. Kocourková. 2012. The Annotated Checklist of Lichens, Lichenicolous and Allied Fungi of Channel Islands National Park. Opuscula Philolichenum 11: 145–302. Available for free download at both Opuscula Philolichenum and on the web site of Channel Islands National Park.

Knudsen, K., J. C. Lendemer and J. Kocourková. 2014. *Lecanora annularis* (Lecanoraceae, Lecanorales), a new lichen species from the Channel Islands and the Central California Coast. Monographs of the Western North American Naturalist 7: 221–224. Available for free download on Research Gate.

Nash III, T.H., B.D. Ryan, P. Diederich, C. Gries and F. Bungartz. 2004. Lichen Flora of the Greater Sonoran Desert Region, Vol. 2, Tempe, Arizona: Lichens Unlimited, Arizona State University, 744 pp.

Nimis, P.L. & M. Tretiach. 2002. *Tornabea*. In: T.H. Nash III, B.D. Ryan, C. Gries and F. Bungartz (eds): Lichen Flora of the Great Sonoran Desert Region, Vol. 1, Arizona: Lichens Unlimited, Arizona State University, page 503.

Sharnoff, S. 2014. A Field Guide to California Lichens. U.S.A.: Yale University Press. 422 pp.

Sipman, H.J.M. 1993. Lichenotheca Latinoamericana a museo botanico berolinensi edita, fasciculum secundum. Willdenowia 23: 305–314.

## Macedonian artist uses lichens to enlighten

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*The gravestones, greenly luminous in the thick dusk, looked as if their ancient lichens might possess some magical power of phosphorescence.* –Sylvia Plath

Macedonian artist Kristina Zimbakova describes her art as “transdisciplinary, bringing together visual art, poetry and natural science by creating paintings that endeavor to push the boundaries.” Many of Zimbakova’s art pieces include specimens of lichens and/or fungi. She obtains the specimens from dry collections or harvests them during personal forays, in collaboration with both Macedonian and foreign scientists, who also assist in identifying the species. In particular, the Macedonian Mycological Society and Skopje fungarium have been important resources for her work.

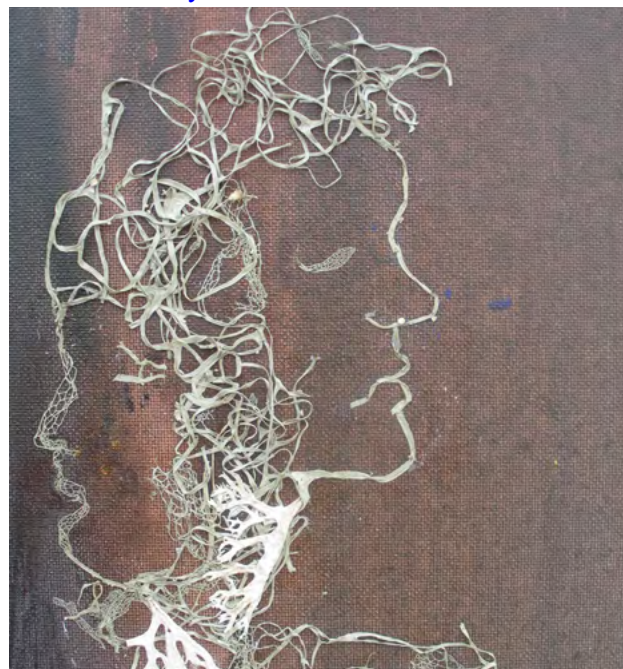
When lace lichen was named as California’s state lichen, Zimbakova reached out to the California Lichen Society to see if she could obtain a specimen of lace lichen for use in her artwork. Since lace lichen grows quite prolifically in many areas of California and often falls to the ground during storms, CALS members were able to safely provide a sizable clump of lichen for inspiration and incorporation into Zimbakova’s art. When asked about collection practices, Zimbakova stressed that sustainability comes first, and she hopes that her careful use of lichen specimens will ultimately lead to increased awareness about these often overlooked organisms. She works with species from across the globe and likes to include their scientific name and place of origin as part of the art piece.

Upon receipt of the lace lichen, Zimbakova created a piece entitled “The Hard One” (“Тешкото”). She says, “The Hard One is an iconic traditional Macedonian male dance called ‘oro’. My dance has only one male in the middle. The [piece shows] the dance climax that I have tried to capture in my artwork when the dance leader gets on the drum.” The image – which uses

both lace lichen and the fungus *Daedalea quercina* – captures both cultural and natural landscapes in a unique and beautiful piece of art. In another piece called “The Harp of my Heart”, Zimbakova highlights the intricate lace lichen nets as they form the features of two faces in profile.

Of her work, Zimbakova says the following: “The closing lines of the poem ‘Mushrooms’ by Sylvia Plath, ‘We shall by morning / Inherit the earth./ Our foot’s in the door.’, have an underlying purport I aim to convey: the fascinating power of poetry via fungi as symbols of poems. I maintain that the aesthetics of nature can faithfully epitomize human states of mind and heart, and that they are intrinsically related just as many fungi are connected to plants or algae in symbioses called mycorrhiza or lichens, respectively.”

To learn more about Kristina Zimbakova’s work, visit [kriszimb.weebly.com/](http://kriszimb.weebly.com/)



Detail from *The Harp of My Heart* (Харфата на моето срце). Acrylic, lichens *Ramalina menziesii* from California & *Evernia prunastri*, silk on canvas; 50 x 70 cm; 2016. Artwork by Kristina Zimbakova.





*The Hard One* (Тешкото). Acrylic, ink, charcoal, fungus *Daedalea quercina*, lichen *Ramalina menziesii* from California, USA, glue on canvas; 50 x 70 cm; 2016. Artwork by Kristina Zimbakova.



*She will Wolf Down Her Heart* (Срцето ќе си го излапа). Acrylic, ink, charcoal, lichen *Usnea* sp. on canvas. 50x60 cm; 2015. Artwork by Kristina Zimbakova.



## Coastal versus inland form of lace lichen, *Ramalina menziesii*

The following text was compiled from *A Field Guide to California Lichens* by S. Sharnoff (2014) and *Lichens of North America* by I. Brodo, S.D. Sharnoff and S. Sharnoff (2001); both of these titles are published by Yale University Press. Text reprinted by permission of Yale University Press.

### SPECIES DESCRIPTION

#### ***Ramalina menziesii*: lace lichen, fishnet lichen**

Thallus pendant, up to 1 m long, with branches that vary from narrow to broad (up to 3 cm) often on the same thallus, with raised ridges and striations, and side branches or tips that form distinctive nets unlike any other North American lichen. Apothecia fairly common but not always present. Extremely variable in growth form.



STEPHEN SHARNOFF

Coastal growth form of lace lichen displaying long, thin branches with few intricate nets; coastal San Luis Obispo County, California.

#### **Coastal form**

In coastal populations, the nets are limited to tiny expansions at the very tips of slender branches. The thallus can become so slender and finely branched along the northwestern coast that it resembles *Alectoria sarmentosa* or *Ramalina thrausta*. In the latter, instead of having nets, the branch tips curl up and become almost granular. The branches are always round in cross section in *Alectoria*, but flat in *Ramalina*; there is no curling and there are no nets formed at the tips in *Alectoria*.

#### **Inland form**

Farther inland, the branches and the nets are much wider.



STEPHEN SHARNOFF

Inland growth form of lace lichen displaying wider strap-like branches with wide netted areas throughout; inland San Luis Obispo County, California.





SARAH MINNICK

Coastal tree heavily laden with lace lichen that can have strands up to a meter long; Point Lobos State Natural Reserve, Monterey County, California.



SARAH MINNICK

Strap-like branches of lace lichen can be up to 3 cm broad, as in this specimen from Point Lobos State Natural Reserve, Monterey County, California.



SHELLY BENSON

Inland growth form of lace lichen with broad areas of intricate netting; Annadel State Park, Sonoma County, California.

Text and photos compiled by Shelly Benson and Sarah Minnick



## Lichen world rocked by new research showing a previously unknown symbiotic partner

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When lichenologists worldwide look back on 2016 it will undoubtedly be remembered as the “year of Spribille”. In what many are considering the most significant finding in lichenology of the past 150 years, Dr. Toby Spribille has demonstrated that there is always more to discover when it comes to biological research. In a July report to the journal *Science*, Dr. Spribille informed the scientific community of his findings of a third novel partner in what had previously been considered a two-partnered approach within the lichen biota (Spribille et al. 2016).

Lichenologists have long accepted the fungal partner, usually from the Ascomycota division, as the single mycobiont in association with an algal partner and/or a cyanobacterium partner. Many lichenologists, biology teachers and naturalist guides have explained this relationship as the fungal partner “discovering agriculture”, in essence farming the algae to provide the fungi with a food source, while providing general protection for the algae including protection from solar radiation and herbivory. This new discovery informs of the presence of another fungal partner that occurs in the cortex, or outer skin, of the lichen thallus. The new partners are single celled yeasts from the Basidiomycota division. Using next generation molecular sequencing technology, Dr. Spribille and his team of researchers concluded that these yeasts are actually part of a new order that they have coined the Cyphobasidiales. Perhaps teachers will have to begin discussing the advent of agriculture as well as the importance of fermentation for lichen lineages going forward.

The actual discovery came from taking a deeper look into a pair of species that cannot be differentiated by molecular methods but are morphologically and chemically dissimilar. While working on a post-doc at the University of Montana, Dr. Spribille further

investigated the relationship between *Bryoria fremontii* and *Bryoria tortuosa* by performing single nucleotide polymorphism in order to determine whether the morphological/chemical differences were due to differences in gene expression. After this tool turned up the presence of the *Chyphobasidium* yeasts Spribille and his research team did further research and determined that the yeasts not only occurred in the *Bryoria* species, but were found in 52 different lichen genera from 6 different continents!

The discovery has set in motion intense discussions about the role of this new symbiont on the structure and chemistry of the lichen it is a part of and will surely lead to many years of intrigue and further research from the lichenological community. Dr. Spribille’s contribution is greatly appreciated.

(Authors note: there is no evidence of any type of fermentation event happening within the lichen with the yeast in question.)

### LITERATURE CITED

Spribille, T., V. Tuovinen, P. Resl, D. Vanderpool, H. Wolinski, M.C. Aime, K. Schneider, E. Stabentheiner, M. Toome-Heller, G. Thor, H. Mayrhofer, H. Johannesson, J.P. McCutcheon. Basidiomycetes yeasts in the cortex of ascomycete macrolichens. *Science*. 10.1126/science.aaf8287 (2016).

## News and Notes

### **CALS grants program awards three grants in 2015, thanks to a generous gift**

The CALS grants program offers small grants to support projects pertaining to the lichens of California. Typically, two grants are awarded each year in the amounts of \$750 and \$1,000.

Early in 2015, the CALS board of directors approved a \$500 increase for that year's grant cycle—allowing for awards of \$1,000 and \$1,250—in hopes of enticing more applicants.

The CALS grants committee received three very high-quality applications in 2015. After anonymous evaluation by committee members, all three proposals received top scores and were recommended for an award. This created a conflict. The grant fund didn't have enough money to support all three projects. The initial suggestion by committee members was to award three grants, each smaller than the expected amounts of \$1000 and \$1250, a workable but ultimately unsatisfying solution.

At this point, Dr. Shirley Tucker, one of the members of the committee, acting on the feelings of all committee members, very generously offered to make a donation of \$1000 towards the grants program. This would allow all applicants to receive the full amount of funding requested.

Thanks to Shirley's generosity, we were able to provide the requested funding for all three projects. The 2015 award recipients and their projects are described below. Our heartfelt thanks to Shirley, and we feel sure that the results of her generosity will add an important page to the book of California lichenology.

By Tom Carlberg, CALS Grants Committee Chair

### **2015 CALS GRANTS PROJECTS**

#### **A checklist of lichens for the Lava Beds National Monument, California**

Principle Investigator: Steve Sheehy

Summary: Lava Beds National Monument, in northeastern California, is rarely visited by lichenologists. The Monument is comprised of roughly 32 different types of basalt and andesite flows, in addition to other unique geologic features. These diverse conditions create a variety of microhabitats in which lichens flourish. However, when I began inventorying lichens at the Monument in 2012, there were only 19 species recorded in the National Park database. Since that time, I have expanded the list to include 159 total species, including three species that previously were unreported in California, and one species new to science. There are three ultimate goals of this project: (1) create a research herbarium at Lava Beds National Monument for other lichenologists and interested members of the general public; (2) create a lichen checklist to be distributed at the visitor's center; and (3) create a flip book with photographs and descriptions of common species for use by park personnel and possibly the general public.



Steve Sheehy

UNKNOWN

### Documenting the lichen biota of the Pine Hill Intrusive Complex

Principal Investigator: Ian D. Medeiros, College of the Atlantic

**Summary:** The Pine Hill Intrusive Complex (located north of Placerville, El Dorado County, California) comprises a pluton of olivine gabbro surrounded by serpentinite, around which are felsic volcanics and metavolcanics. Several species of vascular plants are endemic to the gabbro soils of this site, and both the gabbro- and serpentinite-derived soils in the area support a number of serpentinite indicator taxa.

Although the vascular plants of this site are well-studied, we know of no published studies which have specifically examined the lichen biota of gabbro outcrops in California. Although we do not

believe that the Pine Hill Intrusive Complex is a hotspot of endemism for lichens, as it is for vascular plants, we believe that this geologically distinctive site may support a unique assemblage of lichen species, as has been shown for serpentinite outcrops in California. The goal of this study will be to assess whether the gabbro pluton supports a lichen biota distinct from that of neighboring lithologies. We propose to collect saxicolous and terricolous lichens on gabbro, serpentinite, and adjacent felsic volcanics and metavolcanics to compare lichen diversity across these three lithologies. Although the present investigation will be limited to the Pine Hill Intrusive Complex (which is just one site, albeit a fascinating one), we hope to expand this work in the future to compare lichen diversity across olivine gabbro, hornblende gabbro, and serpentinite in the California Floristic Province.



ELIZABETH SHADLE

Ian Medeiros



**Alpine lichens as bioindicators of climate change in Western North America**

Principal Investigator: Nastassja Noell

Summary: Alpine areas are significantly threatened by climate change. Lichens have the potential to be sensitive bioindicators of climate change in the alpine, giving conservation managers early warning signs of changes in macro and micro habitat quality. Lichens have not yet been evaluated in most alpine monitoring programs in Western North America due to the difficulty of lichen taxonomy and a limited number of available lichenologists in the region. To evaluate the response of lichens to climate change in alpine regions during the past 60 years, we will revisit 91 alpine sites in Western North America that were inventoried in the mid-1950s by lichenologist H.A. Imshaug, including 12 sites in the Southern Cascades and Sierra Nevada Mountains – two mountain ranges that supply the majority of California’s fresh water. NASA’s remote sensing imagery 1972-present will be used to understand changing climatic trends at each site and investigate potential correlations with changes in lichen distribution patterns, to determine which, if any, species of lichens may be effective bioindicators of regional alpine climate change.



Nastassja Noell

UNKNOWN

**Introducing the 2017 CALS officers**

Thanks to all who participated in the recent CALS election and a huge thanks to our elected officers for pledging to work towards advancing the mission of the society: *promoting the appreciation, conservation, and study of California lichens*. Officers begin their two-year term on January 28, 2017.

President Tom Carlberg



SUSAN CALLA

I have a degree in botany from Humboldt State University and have been a cryptogamic botanist specializing in lichens for 16 years, working for the Forest Service, land managers, private contractors, and non-profit organizations. I’ve been a member of the California Lichen Society since 2000, a member of the CALS Board of Directors starting in early 2004, and have been fascinated by lichens since my first introduction to them in the mid-90s. I would very much like to see more CALS members spend more time in the field, actually looking at the variety of lichens in California, in all the diverse habitats in which they occur. A knowledgeable member base can lead to a widespread appreciation for the lichen resources in our state, and can bring individuals to an awareness of the need for including lichens in conservation and planning in California.

My current special interest is ageing lichens that grow on the leaves of coastal evergreen vascular plants, and exploring the lichen flora of parts of California that have rarely been looked at from a lichen perspective.

I'm especially fond of lichens because they are not organisms per se; they only exist as a symbiosis and if the partners are separated, the lichen as we know it ceases to exist. I think this is an apt metaphor for many modern situations.

#### Vice President Hanna Mesraty



HANNA MESRATY

I have been a member of CALS for seven lovely years. My participation has ranged from technologically advancing CALS via digital tools as member-at-large, getting our social media off the ground as the outreach committee chair, and helping refine the processes for producing the *Bulletin of the California Lichen Society* as co-bulletin production editor.

The thing is, my passion for lichens started before CALS, close to 12 years ago in the Pisgah National Forest, North Carolina. One never forgets their first real encounter with lichens or bryophytes. Over the years I have learned so much as a self-made botanist focusing on lichens, bryophytes, and soil crusts. The ecological niches and resourcefulness of these cryptogams is so unique. My curiosities have introduced me to some of the loveliest people in this field, offered me opportunities to teach and learn with experts and enthusiasts, and even work alongside

bryologist Dan Norris at the UC Jepson Herbarium.

By day I design and create programs that engage the public through hands-on interactive workshops, lectures, nature walks, and gatherings for museums, organizations, and even a Los Angeles city park. With that in-mind, I am enthusiastic to enter this next term with CALS as vice president and work towards enhancing and enriching our outreach on our state lichen, California lichens, and connecting more with the lichen community.

#### Secretary Sarah Minnick



SHELLY BENSON

I grew up amidst many lichens in the far north of California, but instead of biology, I chose the challenge of mathematics during my undergraduate career. One of my favorite moments during that time was a math department camping trip during which the chalkboard was strapped to a tree and mathematical proofs were carried out with lichens looking on.

Following a BA in mathematics from Sonoma State University, I earned a graduate degree in wetland conservation from the University of Massachusetts,



Amherst. Since then, I've worked as a restoration ecologist for the National Park Service and county parks agencies, with a focus on sensitive plant communities ranging from wetlands to sand dunes and serpentine barrens.

While enjoying a career in the natural environment and also dabbling in fiber arts hobbies such as knitting, I was drawn to the use of natural materials in fiber arts, including the use of natural dyes for fiber. The history of use and overuse in dye lichens inspired me to learn more about lichen identification and conservation.

In addition to serving as secretary during the last four years (a time of technological advancement and great data migration within CALS) I have enjoyed attending and leading walks, learning from annual meeting speakers, and sharing information about dye lichens and sustainable collection practices. While contributing desktop publishing skills toward the production of many recent issues of the *Bulletin*, I was delighted to help distribute the words of many knowledgeable authors in the field of lichenology.

Since the excitements of *Peltigera*, PayPal, newsletters, and *Niebla* have not worn off, I look forward to another term welcoming enthusiastic new members and helping them find opportunities to connect with lichens through the CALS community.

Treasurer Kathy Faircloth



UNKNOWN

I am a fifth generation Californian, was raised in Northern California, and have had a lifelong love of the nature around us. Vacations were spent exploring the Sierras and all its wonders. Interests included the grand mountains and lakes as well as the smaller details of mosses, flowers, fish, and reptiles. I learned to clean trout when I was nine and explored the insides of the lovely fish. We rescued tadpoles from drying pools of water. While in college I spent a summer as a Girl Scout Counselor leading backpacking trips with the older girls.

A BS in business from San Jose State University led me to a career in computer sciences as a programmer/analyst. For the past 26 years, while raising my children, I have had my own consulting business in telecommunications billing/auditing.

My love of nature continued in my personal life with a long list of classes from seaweeds, intertidal invertebrates, foraging for edibles, ferns, fungi and of course LICHENS. I studied marine biology and served as a docent for the Richardson Bay Audubon Sanctuary. I consider myself a 'generalist' in my knowledge and study of nature. Last November 2015 I received my certification from the University of California as a 'California Naturalist'.

Lichens are visually stunning (with the help of a 10X loupe) and epitomize what I wish we could all learn from nature. I like the focus on mutualism in lichens as opposed to the violence and competition. What 'IS' in nature is interpreted by humans. Some view the lichen relationship as fungi 'using' and/or 'farming' the algae. I prefer the view that each is mutually beneficial to the other.

I joined the California Lichen Society in 2004 and was promptly asked to serve as treasurer. I wanted to contribute to the society in some way and have done so since 2004 by serving as treasurer for all but a few years of that time.



### Full-time lichen curator coming to UC!

The University Herbarium (UC) at University of California, Berkeley has received an endowment for the purpose of hiring a lichen curator to manage their growing collection of lichens from California and the rest of the world. They will be advertising internationally for candidates who have the necessary taxonomic and molecular skills, as well as the connections for collaboration on a world-wide basis.

The endowment comes through the generosity of lichenologist and CALS member Shirley Tucker, who has long understood the need for additional California-based lichenological resources. While the position is that of curator, and involves herbarium, research, and grant-writing duties, the individual filling the position may have the option of sitting on the committees of graduate students, but involves no teaching duties as currently circumscribed.

This development has tremendous potential, not only for UC Berkeley, but for California lichenology in general. The curator position is exclusively for the management of lichens, including (among many others) the recent addition of Judy & Ron Robertson's extensive California collections. For a discipline as varied and underexplored as California lichenology, this is the best news in twenty years!

While Shirley is proud of what she has enabled, she requests that any interest engendered by this brief note be directed to Brent Mishler, Director of the University and Jepson Herbaria. [bmishler@berkeley.edu](mailto:bmishler@berkeley.edu).

By Tom Carlberg

### Dr. Bruce McCune receives the Acharius Medal at the IAL8 in Helsinki, Finland.

More than 300 lichenologists from around the globe gathered in Helsinki, Finland this summer at the International Association of Lichenologists (IAL) meeting. Held every four years, this event provides an opportunity to not only exchange scientific information, but to meet old and new colleagues, network, raise a few brews in lichen camaraderie, and recognize excellence.



PETER STEGEN

Bruce McCune

The Acharius Medal is presented at each IAL meeting in recognition of the life work of distinguished lichenologists. Swedish botanist Erik Acharius (1757-1819) pioneered the taxonomy of lichens and is known as the “father of lichenology.” When the IAL meets, from one to three individuals are awarded this medal. In 2016, North America was honored as Dr. Bruce McCune (Oregon State University), co-founder of Northwest Lichenologists, was recognized for his outstanding accomplishments over the last 30 plus years.

The following is an abbreviated version of the address given by Dr. Peter Crittenden (University of Nottingham, UK) when presenting the medal to Bruce.

Bruce's career in lichen research began in 1977 as a summer teaching assistant for Mason Hale at the University of Montana's Flathead Lake Biological Field Station. Bruce earned a PhD from University of Wisconsin at Madison in forest ecology. In 1987 Bruce began teaching at Oregon State University, in the Department of Botany and Plant Pathology, where he continues to work.

Bruce has published prolifically in journals and books. He is a polymath. His lichen research spans ecology, floristics, conservation, response to pollution, growth and development, and taxonomy. Bruce has described many new species, especially in the genus *Hypogymnia* on which he is a world authority but also in *Bactrospora*, *Hypotrachyna*, *Letharia*,

*Pseudocyphellaria*, *Rhizocarpon*, *Rinodina* and *Trapeliopsis*. Bruce is possibly just as well known in plant ecology circles as he is as a lichenologist and he continues to publish research on ecology in the broad sense. He is an expert on ecological analysis methods and modeling, and is of course the co-author with M.J. Mefford of *PC-ORD. Multivariate Analysis of Ecological Data*. PC-ORD and Hyperniche have revolutionized the way ecologists approach community analysis.

His other books include: *The Lichens of British Columbia*, Part 1. (1994 with Trevor Goward & Del Meidinger); *Macrolichens of the Northern Rocky Mountains* (1995, with Trevor Goward); *Macrolichens of the Pacific Northwest* (1997, with Linda Geiser); *Analysis of Ecological Communities* (2002 with James Grace); *Biotic Soil Crust Lichens of the Columbia Basin* (2007 with Roger Rosentreter); *Montana Lichens: An Annotated List*. (2014 with several others). His books have made field and laboratory identification of lichens much more accessible to citizens, students, and professional naturalists alike.

In addition to being a gifted and prolific researcher, Bruce has made an unstinting contribution to the promotion of lichenology and to the training of several generations of professional lichenologists. He is a founder member of, and the driving energy behind, the Northwest Lichenologists; he is currently their secretary and treasurer and has also served as editor in chief of its associated journal *Monographs in North American Lichenology*.

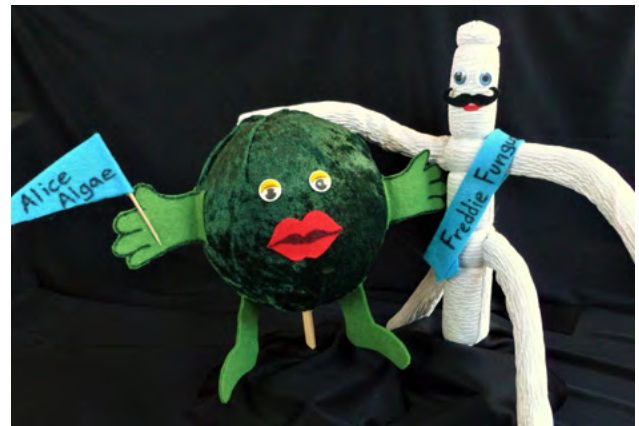
By Peter Crittenden

*Editorial note:* Bruce McCune is a life member of CALS and has contributed articles to the *Bulletin*.

### Freddie Fungus and Alice Alga—educators in residence at the Petaluma Library

The Petaluma Library invited CALS to install a lichen display in the children’s section of the library. Shelly Benson and Sarah Minnick got to work designing and constructing new lichen education models. This effort resulted in stationary puppets of Freddie Fungus and Alice Alga. Fred and Alice took up a four-month residency at the library to spread the word about California’s newest state symbol—lace lichen. Library staff and patrons gave nice compliments on the display and the kids loved it, too, based on the amount of small hand prints all over the glass display case.

By Shelly Benson



SHELLY BENSON

Above: Freddie Fungus and Alice Alga puppets created by Shelly Benson and Sarah Minnick.

Below: Lichen educational materials displayed at the Petaluma Library during the summer of 2016.



SHELLY BENSON

## Upcoming Events

### California Lichen Society Annual Meeting

**Date:** January 28, 2017

CALS members have an opportunity for a distinctly different experience at the January 2017 annual meeting, which also marks the society's 23<sup>rd</sup> birthday celebration. The meeting will be held at The Nature Conservancy's Dye Creek Preserve, near Los Molinos, CA. Because Dye Creek Preserve is a working cattle ranch with an active hunting program, public access is limited. The preserve's manager has been gracious enough to lend the field station at the preserve to CALS for our annual event.

Dye Creek Preserve lies in the heart of the Lassen Foothills region at the north end of the Sacramento River Valley. In the foothills below Mount Lassen, the 37,540 acre preserve is an expansive landscape of blue oak woodlands, volcanic buttes, and rolling wildflower fields that range up to 2,300 feet elevation. It is bounded by Mill Creek to the south and southeast, the Lassen National Forest to the northeast, and State Highway 99 to the west. The preserve has a long history of hog and cattle ranching, and hunting of feral pigs, boar and deer has taken place historically as a routine activity. The preserve has also been managed as a commercial hunting preserve beginning as long ago as 1963.

As always, the day's activities are open to CALS members and also to the general public. Because of the limited access to the preserve, anyone interested in attending must RSVP to [secretary@californialichens.org](mailto:secretary@californialichens.org). Attendees must also sign a liability waiver, which will be provided during the RSVP process. The gate code to access the property will be sent to registered participants shortly before the day of the event.

#### 2017 Annual Meeting Schedule, January 28<sup>th</sup>

Field Trip: 10:00 am – 4:00 pm. Meet at the Dye Creek field station at 10:00 am; we will set out on Dye Creek trail at 10:30. Bring lunch and water, and dress appropriately for the weather.

Social and Open Board Meeting: 4:30 – 5:30 pm:  
Chat with other lichen enthusiasts and sit in on an

open meeting of the CALS Board of Directors—the 2017 board members will be introduced. The board will have an agenda but will be happy to set it aside to hear from members of the society.

Pot-Luck Dinner: 6:00-7:00 pm.

Guest Speaker: 7:00 – 8:00 pm. Guest speaker will be Daphne Stone, lichenologist, specialist in the genera *Leptogium* and *Scytinium*, and president of Northwest Lichenologists

### Northwest Scientific Association Conference

**Date:** March 29 - April 1, 2016

**Location:** Ashland, Oregon

**Registration:** Registration begins in January 2017.

Visit [northwestscience.org](http://northwestscience.org) for details. Register early for reduced rates.

**Description:** The 88th Northwest Scientific Association Conference will be sponsored by Southern Oregon University and Northwest Lichenologists. The conference will explore the theme *Understanding & Managing Diversity: From Landscapes to Genes*. Attendees will enjoy a plenary session, special symposia, concurrent oral and poster sessions, an evening social, workshops, a banquet, and field trips.

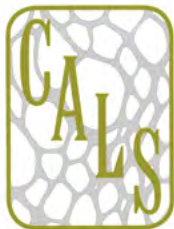
Special symposia include:

- White Oak Restoration
- Understanding Cryptic Diversity
- Traditional Ecological Knowledge
- Natural History in the 21st Century

There is an open call for abstracts in the natural, social, and applied sciences, including, archaeology, botany, bryology, climatology, conservation biology, ecology, fishery biology, forestry, geography, geology, lichenology, restoration ecology, soil science, wetland ecology, wildlife biology, and zoology. The call for abstracts to present oral and poster presentations is open until February 16, 2017.

This is a wonderful opportunity to connect with lichenologists from the Pacific Northwest, and there are usually some great lichen-focused presentations.





## CALS Grant Program

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The California Lichen Society offers small grants to support projects pertaining to the lichens of California. No geographical constraints are placed on grantees or their associated institutions. The CALS Grants Committee administers the program. A grant is awarded only once to a project during its duration.

### 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 CALS Bulletin, based on dissertation, thesis, or other work.
- Budget. Summarize intended use of funds. If you received or expect to receive grants or other 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 high-end items such as computers, software, machinery, or for clothing.
- Academic status. 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.
- Academic support. One letter of support from a sponsor, such as an academic supervisor, major professor, or colleague should accompany your application. The letter can be enclosed with the application or mailed separately to the CALS Grants Committee Chair.
- Your signature, as the person performing the project and the one responsible for dispersing the funds.

The proposal should be brief and concise. The CALS Grants Committee brings its recommendations for funding to the CALS Board of Directors, and will notify applicants as soon as possible of approval or denial.

**Review:** Members of the Grant Committee review proposals once a year. Proposals are evaluated for completeness, technical quality, consistency with CALS goals, intended use of funds, and likelihood of completion. Grant proposals received by October 1 each year will be considered for that year's grant cycle.

**Grant Amounts:** CALS typically offers two grants of \$750 and \$1,000 each year. Usually, two grants are awarded to separate individuals; however, during some years both grants are awarded to one person. Award amounts depend largely on member contributions; therefore, the size of the grants 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 a short article to the *Bulletin of the California Lichen Society*, 3) submit any relevant rare lichen data to California Natural Diversity Data Base using CNDDDB's field survey forms.

**How to submit an application:** Please email applications or questions to the CALS Grants Committee Chair at [Grants@californialichens.org](mailto:Grants@californialichens.org) by **October 1 of the current calendar year**. The current chair is Tom Carlberg.

## President's Message

This has been a great year for lichen awareness. First, California designated lace lichen (*Ramalina menziesii*) as the official state lichen. Then there was the discovery of a hidden fungal partner in lichens. It was exciting to watch how many times lichens popped up in the media—papers, magazines, radio, and news blogs. We wanted to close out the year savoring the sweet taste of success from the state lichen campaign, so this issue is dedicated to lace lichen. I hope you learn something new about the state lichen from this issue and are inspired by the photos and art in such a way that you teach someone about this amazingly beautiful and interesting lichen.

We plan on making 2017 a great year for lichens as well. We'll kick it off at our annual meeting on January 28th at Dye Creek Preserve. It sounds like an ideal location for a lichen fieldtrip, and it has been quite a while since CALS has held an event in north-central CA. At the meeting you'll get a chance to meet the 2017 CALS Board of Directors—many of the same faces, just shuffled positions a bit. I will pass the baton to Tom Carlberg (former vice-president) who will be the new president, and Hanna Mesraty (former member-at-large) will take over as vice president. Kathy Faircloth and Sarah Minnick remain in their positions as treasurer and secretary, respectively. We will welcome several new people to the board in the member-at-large positions. The board is still in the process of appointing those positions, so you'll have to show up to the annual meeting to find out who they are. Or, keep an eye out for an article in the 2017 *Bulletin*.

What will be the focus for CALS in 2017...finding new species, visiting rare lichen occurrences, re-tracing the steps of surveys from decades past, or creating lichen educational materials? It's your call—jump in and help turn these possibilities into CALS events and projects.

Shelly Benson  
[President@californialichens.org](mailto:President@californialichens.org)



LIAM O'BRIEN

Outgoing president, Shelly Benson, lounging on an *Usnea*-covered deck chair along Lagunitas Creek, Point Reyes Station, Marin County.



# CALIFORNIA LICHEN SOCIETY

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PO Box 472, FAIRFAX, CALIFORNIA 94978

The California Lichen Society (CAL S) 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 CAL S 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)

*Find CAL S online!*

[californialichens.org/](http://californialichens.org/)

[twitter.com/CALichenS](https://twitter.com/CALichenS)

[iNaturalist.org/users/cals](https://iNaturalist.org/users/cals)

[facebook.com/californialichens](https://facebook.com/californialichens)

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](http://www.californialichens.org/membership)

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## Board Members of the California Lichen Society

**President** Shelly Benson, [President@californialichens.org](mailto:President@californialichens.org)

**Vice President** Tom Carlberg, [VicePresident@californialichens.org](mailto:VicePresident@californialichens.org)

**Secretary** Sarah Minnick, [Secretary@californialichens.org](mailto:Secretary@californialichens.org)

**Treasurer** Kathy Faircloth, [Treasurer@californialichens.org](mailto:Treasurer@californialichens.org)

**Member at Large** Hanna Mesraty, [MemberAtLarge@californialichens.org](mailto:MemberAtLarge@californialichens.org)

## Committees of the California Lichen Society

**Conservation** Eric Peterson, Chairperson, [Conservation@californialichens.org](mailto:Conservation@californialichens.org)

**Grants** Tom Carlberg, Chairperson, [Grants@californialichens.org](mailto:Grants@californialichens.org)

**Sales** Tom Carlberg Chairperson, [Sales@californialichens.org](mailto:Sales@californialichens.org)

**Activities and Events** vacant, [Activities@californialichens.org](mailto:Activities@californialichens.org)

**Outreach** Hanna Mesraty, Chairperson, [Outreach@californialichens.org](mailto:Outreach@californialichens.org)

**Bulletin** Shelly Benson, Hanna Mesraty, Sarah Minnick, John Villella, [Editor@californialichens.org](mailto:Editor@californialichens.org)





## Lace lichen observations on [iNaturalist.org](https://www.inaturalist.org)

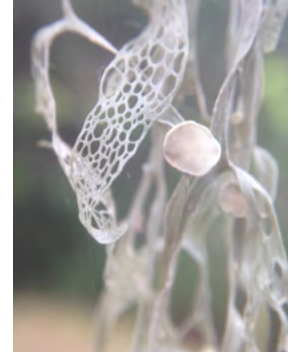
iNaturalist is a place where you can record what you see in nature, meet other nature lovers, and learn about the natural world.



Observer: kueda (Ken-ichi Ueda)  
Location: Sinkyone Wilderness State Park, Mendocino County



Observer: metsa (JK Johnson)  
Location: San Mateo County



Observer: catchang Location: East Bay Municipality Utility District, Contra Costa County



Observer: danielgeorge (Daniel George)  
Location: San Benito County



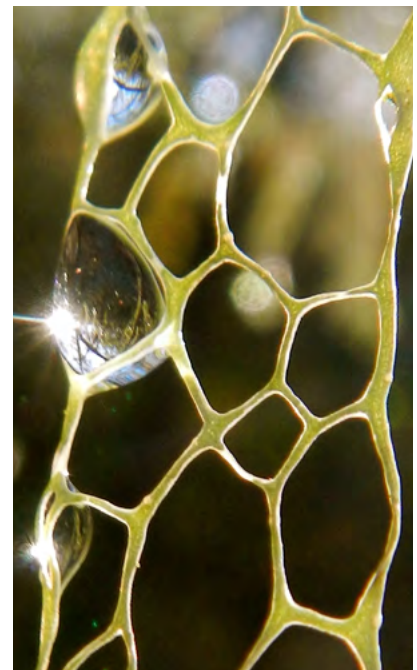
Observer: owicki (Jack Owicki)  
Location: Hopland Research and Extension Center, Mendocino County



Observer: dgreenberger  
Location: Fort Mason, San Francisco County



Observer: abr (Amelia Ryan) Location: San Benito County "Sadly, my photo of the beautiful blue oak tree covered in lace lichen was partly blocked by a large quadruped."



Observer: mikewitkowski  
Location: Sonoma Valley Regional Park, Sonoma County