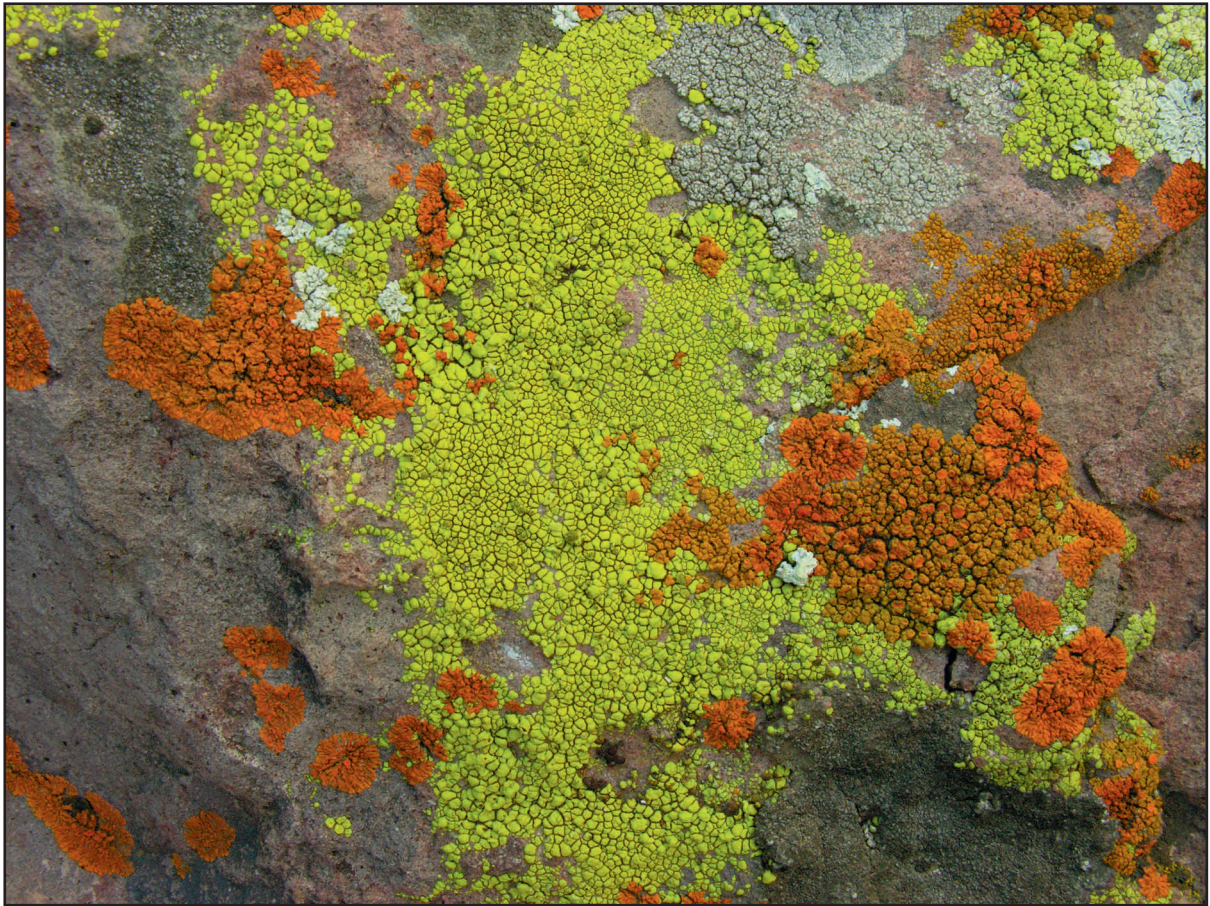


Bulletin
of the
California Lichen Society



Volume 18 No. 1 Summer 2011

The California Lichen Society 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. Dues categories are (in \$US per year): Student and fixed income - \$10, Regular - \$20 (\$25 for foreign members, or \$20 foreign student memberships), Family - \$25, Sponsor and Libraries - \$35, Donor - \$50, Benefactor - \$100, and Life Members - \$500 (one time) payable to the California Lichen Society, PO Box 472, Fairfax, California 94978. Members receive the Bulletin and notices of meetings, field trips, lectures and workshops.

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The deadline for submitting material for the Winter 2011 CALS Bulletin is 15 October 2011.

The California Lichen Society is online at: <http://californialichens.org/> and has email discussions through <http://tech.groups.yahoo.com/group/CaliforniaLichens/>.

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Front Cover: *Acarospora socialis* growing with *Caloplaca* in the Santa Monica Mountains. See article by K. Knudsen page 14. Image by Rolf Muertter. Photo courtesy of Kerry Knudsen.

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The *Usnea rigida* group in California and the Pacific Northwest.

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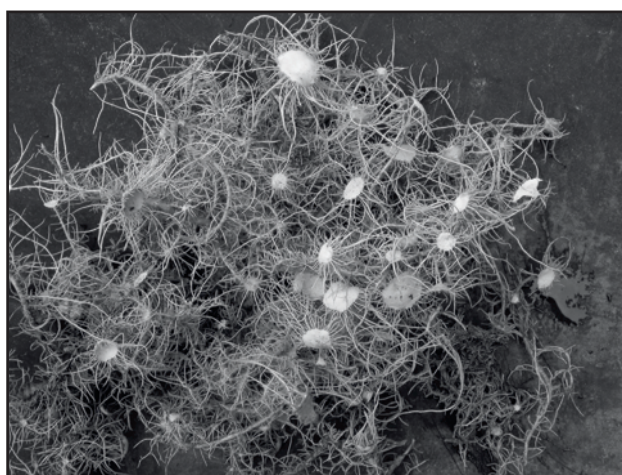
The Usnea rigida group, which is uncommon to rare in California and the Pacific Northwest, has historically been recognized as a complex of morphologically similar species that are distinguished by chemistry. However, some researchers have recently recognized North American members of this group as a single species with multiple chemotypes. Sources in the literature are inconsistent in their treatment of this group, and further work is needed to clarify variations in taxonomic treatments.

KEYWORDS: *Usnea arizonica*, *Usnea florida*, *Usnea rigida* group, *Usnea intermedia*, *Usnea quasirigida*

The *Usnea rigida* species complex is uncommon to rare on the west coast of North America, where it has been documented in California, Washington, and British Columbia (Brodo et al. 2001, McCune and Geiser 2009). This species group has a tufted growth form and is distinguished from other *Usnea* species on the west coast by the presence of abundant apothecia and the absence of soredia or isidia (McCune and Geiser 2009). Although *Usnea florida* is also fertile and lacks vegetative propagules, reports of

this species from the west coast of the USA are believed to be misidentified members of the *U. rigida* group (Tucker and Ryan 2011, pers. com. Tucker). Other west coast *Usnea* species may occasionally be fertile, but these generally have isidia or soredia.

Usnea has long been recognized as one of the most taxonomically challenging lichen genera, and the taxonomy of the *U. rigida* species complex is still poorly understood at this time (Halonen 1998; Lendemer and Tavares 2003). Lichens of the *U. rigida* species complex are morphologically similar and are distinguished by chemistry. This group



Usnea rigida sens. lat. from Saturna Island.
Photography by Daryl Wright.

includes several historically-recognized species whose taxonomic merit is dubious; further work is needed to determine whether these distinct chemotypes warrant specific status (Clerc 2007; Lendemer and Tavares 2003; pers. com. James Lendemer).

Two species of the *U. rigida* group, *Usnea quasirigida* (syn. *U. rigida*) and *Usnea intermedia* (syn. *Usnea arizonica*), are widely recognized on the temperate west coast of North America. *U. quasirigida* is rarely reported from low-elevation, mesic sites in northern Washington state and southern British Columbia (McCune and Geiser 2009); *U. intermedia* is well-documented in Northern California on the west slope of the Coast Range from Humboldt County to San Francisco, and there are several records from farther south along the coast as well (Brodo et al. 2001; pers. com. Curtis Björk and Bruce McCune). *U. retifera* is another historically-recognized member of this group reported from interior California near Fresno (Tucker and Ryan 2011); Tavares (1997) considers it to be synonymous with *U. intermedia*.

Usnea intermedia contains salazinic acid and is distinguished from *U. quasirigida*, which contains protocetraric acid, by its K+ yellow to orange reaction (Clerc 2003; Lendemer and Tavares 2003; McCune and Geiser 2009). However, there are reports of uncommon K-, P-forms of *U. intermedia* (Clerc 2003; Brodo 2001) that would key as *U. florida* in McCune and Geiser's most recent key to macrolichens (2009); these have been collected in Humboldt County, California (pers. com. Tom Carlberg). The

relationship between *U. florida* and the *U. rigida* group has apparently been a matter of confusion for some time; Lendemer and Tavares (2003) defined *U. florida* and *U. florida* var. *rigida*, which contain thamnolic and hypothamnolic acid, as synonymous and distinct from *U. rigida* sens. lat. and *U. quasirigida*.

Although there are numerous reports of *U. florida* in California, it appears that all of these are actually misidentified members of the *U. rigida* group (Tucker and Ryan 2011; pers. com. Shirley Tucker), probably *U. intermedia*. In the first edition of "Macrolichens of the Pacific Northwest" (McCune and Geiser 1997), all fertile *Usnea* spp. lacking soredia and isidia keyed as *U. florida*, which was the name McCune used to represent the entire *U. rigida* group (pers. com. Bruce McCune). All reports of *U. florida* that I encountered were collected before 1950 (pers. com. Shirley Tucker), when other names for the *U. rigida* group on the west coast were apparently not well established, or between 1997 and 2009, when McCune and Geiser's first edition was in use. McCune and Geiser's second edition (2009) keys *U. florida* as well as *U. quasirigida* and *U. intermedia*, but lists *U. florida* as unconfirmed in the Pacific Northwest.

Clerc (2007) indicated that, in North America, *U. florida* occurs only in Mexico. Clerc (2007) placed *U. rigida*, *U. arizonica*, and *U. retigera* in synonymy with *U. intermedia* based on their morphological similarity, but other sources in the literature are inconsistent in regards to the taxonomy of these species (Brodo et al. 2001; Lendemer and Tavares



Usnea rigida sens. lat. from Saturna Island.
Photography by Daryl Wright.

2003; McCune and Geiser 2009). Many lichenologists and sources in the literature continue to make specific distinctions between the salazinic and protocetraric chemotypes, but the placement of the *U. arizonica* and *U. retigera* in synonymy with *U. intermedia* is widely accepted (Esslinger 2010; McCune and Geiser 2009; pers. com. James Lendemer).

Lendemer and Tavares (2003) introduced the name *U. quasirigida* to replace the historically troubled and confusing *U. rigida*. However, some lichenologists on the west coast do not recognize the name *U. quasirigida* and continue to use *U. rigida* because Lendemer and Tavares (2003) did not examine specimens from the west coast, which may be chemically distinct from the European type specimens they examined (pers. com. Curtis Björk). Lendemer and Tavares (2003) give only a general description of *Usnea rigida* sens. lat. (which they say "probably has included *U. intermedia*") and do not give detailed descriptions of the chemistry and range of

the different chemotypes (or species). It appears that there will be no clear answers regarding the taxonomy of this group until further studies that include genetic analysis are completed.

ACKNOWLEDGMENTS

I wish to thank Curtis Björk, Tom Carlberg, Ted Esslinger, Linda Geiser, Larissa Laselle, James Lendemer, Bruce McCune, Daphne Stone, and Shirley Tucker for providing information about these species and collection records. Thanks also to Daryl Wright for providing photos for this article.

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"Divergent Fault" lichens of the North Cascades magnified 60x.
Artwork by Angela Mele.

Results from a Lichen BioBlitz at Crater Lake National Park, with Additions to the Lichen Species List

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Lichens were collected and determined by volunteers for a BioBlitz event with the goal of increasing known records of lichen species in Crater Lake National Park. Five sites were visited and collections were made by volunteers and park staff on one day. From these collections 74 species representing 30 genera were cataloged. 59 species represent additions to the list of species previously known from the park. An updated lichen list for Crater Lake National Park is presented.

INTRODUCTION

Crater Lake National Park (CRLA) is situated on the crest of the Cascade Mountains in Klamath County, Oregon. This national park has large areas of undisturbed alpine and montane habitats and a correspondingly diverse assemblage of cryptogam communities. On August 23, 2008 CRLA sponsored a Lichen BioBlitz to collect and identify lichens within the park boundaries with the goal of increasing the known flora of lichens from the park.

The term "BioBlitz" was coined by U.S. National Park Service naturalist Susan Rudy who assisted with the first BioBlitz that took place at Kenilworth Aquatic Gardens in Washington D.C. A classic BioBlitz is a 24-hour event in

which scientists, students, and community volunteers race to find, collect, and identify as many species as possible across multiple taxonomic groups. Participants learn about local organisms in a spirit of adventure while gaining a better understanding of the ecological services they provide. Besides promoting "citizen science" and conservation, these events also provide useful educational tools that celebrate the biological diversity found in public green spaces. Since the inception of the BioBlitz concept these events have been held in urban parks, like New York City's Central Park and Taipei Peace Park in Taiwan, and also on Nature Conservancy preserves, federal lands, and at Walden Pond.

In British Columbia Canada the Whistler Biodiversity Project has sponsored a Bioblitz event annually since 2007 within the Whistler Municipal boundary and has recorded 2,136 species from all taxa groups including 372 lichens (Whistler Biodiversity project website).

In 2007, CRLA Science and Learning Center sponsored the park's first BioBlitz in which plant experts surveyed a *Sphagnum* bog for vascular plants and bryophytes. The 2008 Lichen BioBlitz was the first BioBlitz at the park open to the general public, and others are planned for

future years focusing on other taxa groups.

METHODS

Volunteers from the community at large were recruited through articles in the local newspapers (Medford Mail Tribune) and through articles in newsletters of various non-profit groups associated with CRLA (Crater Lake Trust, Friends of Crater Lake etc.). On the day of the BioBlitz volunteers were given an introductory presentation about lichen diversity and ecology before going out into the field. Sites were chosen to represent a diversity of habitats within the park while allowing easy access by volunteers. This was done to maximize efficiency of collecting with the limited time available.

One group leader and a group of volunteers visited each site. Five teams, consisting of park staff and 42 community volunteers, collected lichens from five locations. An attempt was made to collect as much of the lichen diversity at each site as possible, but collections returned tended to be of epiphytic and corticolous species with less saxicolous collections made. Volunteers also tended to favor macrolichens. Although not generally targeted, many microlichens were present in the collections in large enough abundance to be determined. Lichen collections were determined by the authors using standard techniques and deposited with CRLA.

STUDY AREA

Crater Lake National Park is Oregon's only national park and as it has been set aside from major development since 1902, it represents a valuable relatively a

undisturbed area for lichen diversity in the southern Cascade Mountains. It sits upon the Cascade crest and straddles the divide between vastly different habitats ranging from wetter forests in the west to drier shrub steppe in the east. Aside from the iconic lake that serves as the park's main attraction there are a diversity of interesting well preserved habitats for lichens found within the park's boundaries. Habitats include conifer dominated forests, pumice flats, open rocky barrens, sphagnum bogs, headwater streams, chaparral, and alpine meadows. Due to the short time of the BioBlitz only a subset of habitats was visited. The sites visited are: Annie Creek, Castle Crest, Cloudcap, Godfrey Glen Trail, and Ponderosa (Figure 1). These sites are briefly described below.

Annie Creek: Elevation 1786 m (5860 ft) UTM: 10T 0576887E, 4745722N. Stream side forested site dominated by *Pseudotsuga menziesii* and *Pinus contorta*. The soils are Badland-Stirfry Complex, with a slope of 0-70%.

Ponderosa: Elevation, 1378 m (4520 ft) UTM: 10T 0576709E, 4736230N. Low elevation forested site dominated by *Pinus ponderosa*, *Abies concolor*, *Abies x shastensis* and *Pseudotsuga menziesii*. The soils are Collier ashy loamy sand, Stirfry Riverwash Complex and Collier-Badland Complex, with a slope of 2-100%.

Castle Crest: Elevation, 2213 m (7260 ft) UTM: 10T 0570969E, 4748983N. Open meadow habitat dominated by forbs and rock outcrops with forests dominated by *Tsuga mertensiana* and *Abies x shastensis*.

The soils are Liao Rock-rubble land - rock outcrop.

Godfrey Glen: Elevation, 1842 m (6044 ft) 10T 0569877E, 4746044N. Old-growth forest dominated by *Tsuga mertensiana* and *Abies x shastensis*. The soils are Castle Crest gravelly ashy sandy loam, with a 2-10% slope.

Cloud Cap: Elevation, 2398 m (7868 ft) UTM: 10T 0577725E, 4753968N. Open rocky high elevation site dominated by *Pinus albicaulis*. Soils: Castle Crest gravelly ashy loamy sand, with a 5-45% slope.

RESULTS

A total of 74 lichens were identified from the BioBlitz collections. Fifty nine species representing 30 genera, including 36 microlichens are additions to the known lichen flora of the park. The results of the BioBlitz have been combined with the NP lichen checklist to produce a checklist of documented lichens for CRLA (Table 1). One lichen collected during the 2007 BioBlitz is also included because it is also an addition to the flora. None of the specimens cited by NP lichens were examined by us. The person who identified Bioblitz specimens are abbreviated as: RD (Rick Demmer), KM (Kristi Mergenthaler) and JV (John

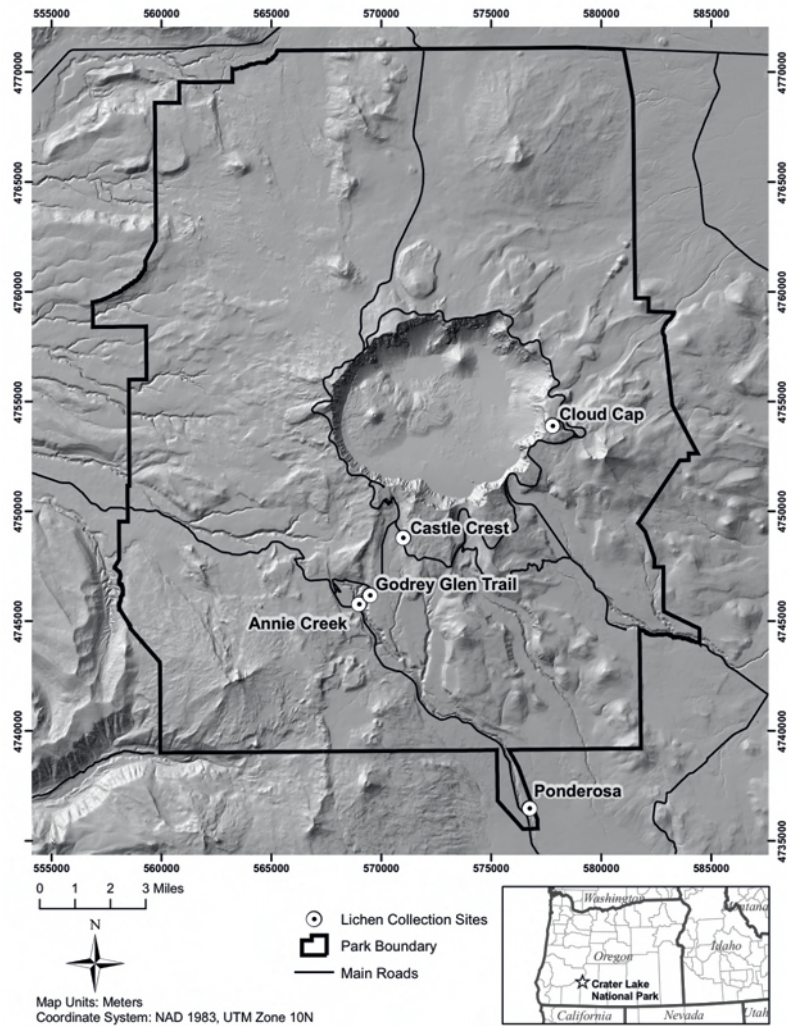


Figure 1. Lichen Bioblitz collection sites within Crater Lake National Park.

Villella). Other reference codes are from the National Park List. The Bioblitz Locations are abbreviated as follows: AC (Annie Creek), CC (Castle Crest), CL (Cloud Cap), GG (Godfrey Glen), PO (Ponderosa).

DISCUSSION

The lichen diversity of Crater Lake National Park is not yet completely known. Despite a long history of collecting in the park the list that appears

on the NPlichen database was estimated to include only between 26 and 50 percent of the expected flora (Bennett and Wetmore 2005). While there are 13 references of Crater Lake lichens in the literature (NPlichen database), most of the lichen collections cited are from papers dealing with taxonomy in specific groups across large geographic areas (Thomson, J. 1950), (Thomson, J. 1991), (Herre, 1946), (Brodo, I. & D. Hawksworth. 1977), (Llano, G. 1950) or are descriptions of new species from the park (Herre, 1944). Of these only one paper deals with species diversity in the park (Sipe, F. 1943). The collections referred to in this paper were Sipe's and limited to locations in and around the crater on the north side of the lake.

Although this BioBlitz nearly doubled the known species for CRLA, many functional groups (cyanolichens, pin lichens) and genera (*Cladonia*, *Fuscopannaria*, *Caloplaca*) remain under recorded for the park (McCune, pers. comm. 2009). Habitats that would most likely yield new additions to the parks flora include: aquatic habitats, springs and seeps, sphagnum dominated alpine areas, rock outcrops, barrens and talus slopes.

The BioBlitz is an excellent tool for gathering biodiversity data and for providing hands-on natural science education to the public. With changing climatic conditions, it is essential to develop baseline biodiversity data that can be used to monitor shifts in lichen community composition. Properly conducted BioBlitz events can be useful cost effective tools for generating this type of data.

ACKNOWLEDGEMENTS

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View of Crater Lake National Park from the air. Photography by Erin P. Martin.

Table 1: List of lichens known from Crater Lake National Park. None of the specimens cited by NP lichens were examined by us. The person who identified Bioblitz specimens are abbreviated as: RD (Rick Demmer), KM (Kristi Mergenthaler) and JV (John Villella). Other reference codes are from the National Park List. The Bioblitz Locations are abbreviated as follows: AC (Annie Creek), CC (Castle Crest), CL (Cloud Cap), GG (Godfrey Glen), PO (Ponderosa).

Species	Reference Code	Locations	NP Lichen	Bioblitz 2008
<i>Acarospora americana</i> H. Magn.	MIN Herb.		X	
<i>Acarospora badiofusca</i> (Nyl.) Th. Fr.	RD	AC		X
<i>Acarospora fuscata</i> (Schrader) Arnold	MIN Herb.		X	
<i>Acarospora smaragdula</i> (Wahlenb.) A. Massal.	Sipe 1943		X	
<i>Ahtiana pallidula</i> (Tuck. Ex Riddle) Goward & Thell	JV	PO		X
<i>Alectoria imshaugii</i> Brodo & D. Hawksw.	RD, KM, JV MIN Herb.; RD,	GG, CC, PO		X
<i>Alectoria sarmentosa</i> (Ach.) Ach.	JV	GG, PO	X	X
<i>Amandinea punctata</i> (Hoffm.) Coppins & Scheid.	RD	GG		X
<i>Arthonia apatetica</i> (A. Massal.) Th. Fr.	RD	GG		X
<i>Aspicilia caesiocinerea</i> (Nyl. ex Malbr.) Arnold	RD	CC		X
<i>Aspicilia cinerea</i> (L.) Körber	Sipe 1943		X	
<i>Aspicilia tenuis</i> H. Magn.	Magnusson 1939		X	
<i>Bacidia circumspecta</i> (Nyl. ex Vainio) Malme	RD	PO		X
<i>Bellemerea cinereorufescens</i> (Ach.) Clauzade & Cl. Roux	Sipe 1943		X	
<i>Bellemerea sanguinea</i> (Kremp.) Hafellner & Cl. Roux	Magnusson 1939		X	
<i>Biatora subduplex</i> (Nyl.) Printzen (Printzen 1995)	JV	AC		X
<i>Bryoria capillaris</i> (Ach.) Brodo & D. Hawksw.	JV	PO		X
<i>Bryoria fremontii</i> (Tuck.) Brodo & D. Hawksw.	Sipe1943		X	
<i>Bryoria fuscescens</i> (Gyelnik) Brodo & D. Hawksw.	RD	GG		X
<i>Bryoria lanestris</i> (Ach.) Brodo & D. Hawksw.	Brodo & Hawksworth		X	
<i>Bryoria pseudofuscescens</i> (Gyelnik) Brodo & D. Hawksw.	RD	GG		X
<i>Bryoria trichodes</i> (Michaux) Brodo & D. Hawksw.	MIN Herb.		X	
<i>Buellia triseptata</i> A. Nordin	RD	PO		X
<i>Calcioplaca holocarpa</i> (Hoffm. ex Ach.) A. E. Wade	JV	PO		X
<i>Calicium adaequatum</i> Nyl.	JV	GG		X

Table 1 (Cont.): List of lichens known from Crater Lake National Park.

Species	Reference Code	Locations	NP Lichen	Bioblitz 2008
<i>Calicium glaucellum</i> Ach.	JV	PO		X
<i>Calicium viride</i> Pers.	JV	PO		X
<i>Candelaria concolor</i> (Dickson) Stein	JV	PO		X
<i>Cladonia chlorophaea</i> (Flörke ex Sommerf.) Sprengel	Park list; JV,KM	CC, AC	X	X
<i>Cladonia fimbriata</i> (L.) Fr.	Sipe 1943		X	
<i>Cladonia pyxidata</i> (L.) Hoffm.	Park list		X	
<i>Cyphelium inquinans</i> (Sm.) Trevisan	RD, JV	PO		X
<i>Dermatocarpon miniatum</i> (L.) W. Mann	Sipe 1943		X	
<i>Dermatocarpon reticulatum</i> H. Magn.	MIN Herb.; KM	CC	X	X
<i>Diploptomma penichrum</i> (Tuck.) Szatala	RD, JV	GG, PO		X
<i>Evernia prunastri</i> (L.) Ach.	Park list; JV	PO	X	X
<i>Hypogymnia enteromorpha</i> (Ach.) Nyl.	MIN Herb.		X	
<i>Hypogymnia imshaugii</i> Krog	KM, RD, JV	GG, CC, CL		X
<i>Hypogymnia occidentalis</i> L. Pike	RD	GG, AC		X
<i>Hypogymnia tubulosa</i> (Schaerer) Hav.	RD	AC		X
<i>Hypogymnia wilfiana</i> Goward, T. Sprib. & Ahti	RD	GG		X
<i>Japewia subaurifera</i> Muhr & Tønsberg	RD	GG		X
<i>Kaernefeltia merrillii</i> (Du Rietz) Thell & Goward	JV	PO		X
<i>Lecania cyrtella</i> (Ach.) Th. Fr.	JV	PO		X
<i>Lecanora applegatei</i> Herre	MIN Herb.		X	
<i>Lecanora cadubriae</i> (A. Massal.) Hedl.	RD	AC, PO		X
<i>Lecanora carpinea</i> (L.) Vainio	JV	PO		X
<i>Lecanora circumborealis</i> Brodo & Vitik.	Sipe1943, RD, JV	GG, PO, CC	X	X
<i>Lecanora fuscescens</i> (Sommerf.) Nyl.	RD	GG		X
<i>Lecanora polytropa</i> (Hoffm.) Rabenh.	Sipe 1943; JV	AC	X	X
<i>Lecanora pringlei</i> (Tuck.) Lamb	Sipe 1943		X	
<i>Lecanora rupicola</i> (L.) Zahlbr.	Sipe 1943		X	
<i>Lecanora symmicta</i> (Ach.) Ach.	JV	PO		X
<i>Lecanora varia</i> (Hoffm.) Ach.	JV	AC		X
<i>Lecanora zosteriae</i> (Ach.) Nyl.	JV	PO		X
<i>Lecidea atrobrunnea</i> (Lam. & DC.)	RD	CC		X
<i>Lecidea auriculata</i> Th. Fr.	Sipe 1943 Sipe 1943;		X	
<i>Lecidea cascadenensis</i> H. Magn.	Magnusson 1939		X	
<i>Lecidea fuscoatra</i> (L.) Ach.	Sipe 1943		X	
<i>Lecidea leucothallina</i> Arnold	Anderson 1965		X	
<i>Lecidea pumicicola</i> H. Magn.	Sipe 1943		X	
<i>Lecidea sp.</i> Ach.	RD	GG		X

Species	Reference Code	Locations	NP Lichen	Bioblitz 2008
<i>Lecidella euphorea</i> (Flörke) Hertel	RD	GG, CC		X
	Magnusson 1939;			
<i>Lecidella stigmataea</i> (Ach.) Hertel & Leuckert	RD	AC	X	X
<i>Lepraria incana</i> (L.) Ach.	JV, RD	GG, AC		X
<i>Lepraria niavalis</i> J. R. Laundon	KM	CC		X
<i>Lepraria</i> Ach.	JV	PO		X
<i>Letharia columbiana</i> (Nutt.) J. W. Thomson	KM	CC, CL		X
	Park list; RD, KM,			
<i>Letharia vulpina</i> (L.) Hue	JV	GG, CL, PO	X	X
<i>Melanohalea exasperatula</i> (Nyl.) O. Blanco et al.	RD, JV	GG, PO		X
<i>Melanohalea multispora</i> (A. Schneider) O. Blanco et al.	RD	PO		X
<i>Melanohalea subolivacea</i> (Nyl.) O. Blanco et al.	JV	PO		X
<i>Melanelixia subargentifera</i> (Nyl.) O. Blanco et al.	Herre1946		X	
<i>Nephroma resupinatum</i> (L.) Ach.	Park list		X	
<i>Nodobryoria abbreviata</i> (Müll. Arg.) Common & Brodo	RD, JV, KM	GG, CL, PO		X
<i>Nodobryoria oregana</i> (Tuck.) Common & Brodo	Sipe 1943		X	
<i>Ochrolechia farinacea</i> Howard	JV	CC		X
<i>Ochrolechia juvenalis</i> Brodo	RD, JV	GG, PO		X
<i>Ochrolechia oregonensis</i> H. Magn.	JV	PO		X
	Kalb & Staiger			
<i>Ophioparma rubricosa</i> (Müll. Arg.) S. Ekman	1995		X	
<i>Ophioparma ventosa</i> (L.) Norman	MIN Herb.		X	
<i>Parmelia hygrophilia</i> Goward & Ahti	RD	AC		X
<i>Parmelia sulcata</i> Taylor	Sipe 1943; RD	GG	X	X
<i>Parmeliopsis ambigua</i> (Wulfen) Nyl.	KM, JV	CC, CL, AC		X
<i>Parmeliopsis hyperopta</i> (Ach.) Arnold	RD, JV	GG, AC		X
<i>Peltigera canina</i> (L.) Willd.	Park list		X	
	CRLA BioBlitz			
<i>Peltigera didacyla</i> (With.) J. R. Laundon	2007			
<i>Peltigera rufescens</i> (Weiss) Humb.	Park list		X	
<i>Pertusaria</i> sp. DC.	RD	GG		X
<i>Platismatia glauca</i> (L.) Culb. & C. Culb.	Park list; JV	PO, AC	X	X
	MIN Herb. Sipe			
<i>Pleopsidium flavum</i> (Bellardi) Körber	1943		X	
<i>Porpidia macrocarpa</i> (DC.) Hertel & A. J. Schwab	Sipe 1943		X	
<i>Pseudephebe minuscula</i> (Nyl. ex Arnold) Brodo & Hawksw.	Park list		X	

Table 1 (Cont.): List of lichens known from Crater Lake National Park.

Species	Reference Code	Locations	NP Lichen	Bioblitz 2008
<i>Pseudophebe pubescens</i> (L.) M. Choisy	Magnusson 1939		X	
<i>Pseudocyphellaria anthraspis</i> (Ach.) H. Magn.	Park list		X	
<i>Ptychographa xylographoides</i> Nyl.	JV	AC		X
<i>Pyrrhospora russula</i> (Ach.) Hafellner	Sipe 1943		X	
<i>Ramalina farinacea</i> (L.) Ach.	Sipe 1943		X	
<i>Ramboldia elabens</i> (Fr.) Kantvilas & Elix	Sipe 1943		X	
<i>Ramboldia gowardiana</i> (T. Sprib. & Hauk) Kalb, Lumbsch, Elix	JV, RD	AC		X
<i>Rhizocarpon geminatum</i> Körber	Magnusson 1939		X	
<i>Rhizocarpon geographicum</i> (L.) DC.	Magnusson 1939		X	
<i>Rhizoplaca melanophthalma</i> (DC.) Leuckert & Poelt	Magnusson 1939		X	
<i>Rimularia gyrizans</i> (Nyl.) Hertel & Rambold	JV	AC		X
<i>Rinodina boulderensis</i> Sheard	RD	PO		X
<i>Rinodina freyi</i> Sheard	RD	GG		X
<i>Shaeriria dolodes</i> (Nyl. ex Hasse) Schmull & T. Sprib.	RD	GG		X
<i>Solorina crocea</i> (L.) Ach.	Sipe 1943		X	
<i>Staurothele drummondii</i> (Tuck.) Tuck.	Thomson 1991		X	
<i>Tephromela atra</i> (Hudson) Hafellner	JV	PO		X
<i>Trapeliopsis granulosa</i> (Hoffm.) Lumbsch	Sipe1943; JV	GG	X	X
<i>Tuchkermannopsis chlorophylla</i> (Willd.) Hale	RD, JV	GG, PO		X
<i>Tuchkermannopsis orbata</i> (Nyl.) M. J. Lai	RD	GG		X
<i>Tuchkermannopsis platyphylla</i> (Tuck.) Hale	KM, JV, RD	GG, CC, PO		X
<i>Umbilicaria decussata</i> (Vill.) Zahlbr.	Sipe 1943		X	
<i>Umbilicaria hyperborea</i> (Ach.) Hoffm.	Sipe 1943		X	
<i>Umbilicaria krascheninnikovii</i> (Savicz) Zahlbr.	Llano 1950		X	
<i>Umbilicaria phaea</i> Tuck.	Llano 1950		X	
<i>Umbilicaria torrefacta</i> (Lightf.) Schrader	Sipe 1943		X	
<i>Umbilicaria vellea</i> (L.) Hoffm.	Sipe 1943		X	
<i>Umbilicaria virginis</i> Schaerer	MIN Herb.		X	
<i>Usnea filipendula</i> Stirton	Park list; JV	PO	X	X
<i>Vulpicida canadensis</i> (Räsänen) J.-E. Mattsson & M. J. Lai	Park list: JV	PO	X	X
<i>Xanthoparmelia conspersa</i> (Ehrh. ex Ach.) Hale	Park list			
<i>Xanthoria elegans</i> (Link) Th. Fr.	Park list		X	
<i>Xanthoria polycarpa</i> (Hoffm.) Th. Fr. Ex Rieber	JV	PO		X

An Adventure in Ethnolichenology

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The bright yellow *Acarospora socialis* H. Magn. (figure 1.) is the one of the most common as well as most conspicuous lichens in California and Arizona. It is a hardy pioneer and grows in many different microhabitats from the Channel Islands to the Mojave and Sonoran deserts on granite and other silicate rich rock (Knudsen 2007). Like many successful species with wide ecological amplitude, it is variable in appearance. This has led to it being named as a new species many times. It is easily identified by its formation of a stipe, but as with several other stipe-forming *Acarospora*, like *A. thamnina* (Tuck.) Herre, parts of a population may be slow in forming a stipe, especially in bad conditions or directly above the spray zone along the coast.

Morro Rock (figure 2.) is a massive volcanic rock rising above Morro Bay and the Pacific Ocean, administered by the local California State Park district. It is closed to the public both because it is steep as well as because it is a sacred site of the Salinan and Chumash peoples. To collect on Morro Rock you need both a state permit as well as the permission of the Native American tribes who protect the site and still perform rituals on its summit.

Morro Rock has a large flat rocky top and a long slope facing the ocean rich in lichens, especially many maritime species

such as *Acarospora robiniae* K. Knudsen, *Aspicilia pacifica* Owe-Larss. & A. Nordin, *Caloplaca bolacina* (Tuck.) Herre, *Niebla ceruchoides* Rundel & Bowler, *Niebla polymorpha* Bowler, J.E. Marsh, T.H. Nash, & Riefner, *Schizopelte californica* Th. Fr., and *Schizopelte parishii* (Hasse) D. Ertz & Tehler (formerly *Hubbsia parishii*). There is also a lot of *Acarospora socialis*.

Both times I have collected on Morro Rock I was accompanied by John Birch, a traditional leader for the Salinan Tribe. The first time I was with botanist David Kiel and state park ecologists Mike Walgreen and Lisa Andreano. On the summit, before we started collecting, John

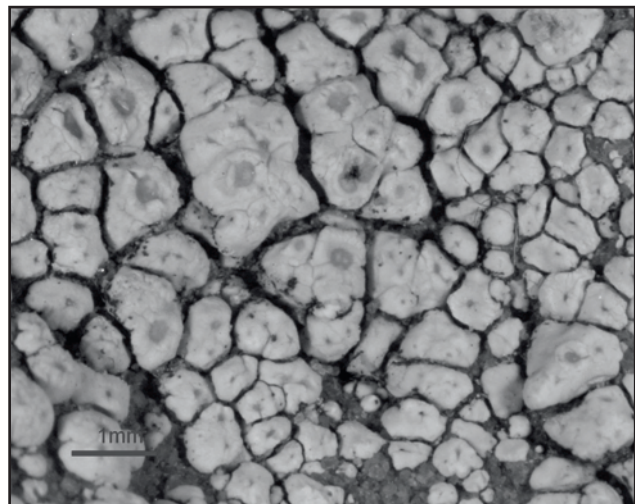


Figure 1. *Acarospora socialis* from Coconino National Forest, Yavapai County, Arizona. Photography by J. C. Lendemer.

Birch told us the rock had a female side and a male side. David Kiel and my friends took off to look at plants on the male side. But I told John I will start on the female side because I have always been watched over by feminine angels. He nodded in approval. Later in the day I went on the summit to collect and John Birch was there smoking a cigarette and talking on a cell phone. He joined me and pointed at a yellow lichen covering the volcanic rock.

"Whats the name of that one?"

I replied, 'Thats *Acarospora socialis*.' He became excited and told me his people once used it in a hallucinogenic brew for mystical rituals. He had been told about it by his grandmother but how to make the brew and what the other ingredients were had been lost. "Do you know what is in it?"

I told him it contained rhizocarpic acid. I explained that I doubted it had any psychedelic effect but it might have acted synergistically with the other ingredients, possibly activating some alkaloid in a plant. I collected a specimen on the spot and sent it to Jack Elix in Australia. Jack analyzed it with HPLC and it contained only rhizocarpic acid and epanorin, a related substance common in yellow *Acarospora*. So whatever formula they used for their ritual hallucinogenic brew, *Acarospora socialis* was not the active ingredient.

A year later I was collecting near a trail on Santa Rosa Island. The rocks were covered with maritime *Buellia* and *Acarospora socialis*. Two men were hiking back from the east end and stopped to cool off and chat with me. They asked



Figure 2. Morro Rock from the Pacific Ocean. Photography by Jana Kocourková.

me about the lichens and eventually I told them the story about *Acarospora socialis* being used in a hallucinogenic brew. One of the men a Native American, whose name was Harold, had a story to tell. He was from Arizona and he had heard that one of the tribes that live around the Grand Canyon (there are four) used a yellow lichen in a hallucinogenic brew. But he did not know anymore than that. It did not have to be *Acarospora socialis*, which is common in the Grand Canyon. It could be, for instance, a yellow *Rhizocarpon*. Whatever it was, because it was yellow, it might contain rhizocarpic acid.

I am a fungal taxonomist, who works on lichens and lichenicolous fungi, and when it comes to getting high I will stick with alcohol or marijuana. I am not interested in experimenting with lichens as intoxicants. Besides, there is a real chance of lichen substances taken in large quantities could cause kidney damage, etc., while other substances like vulpinic acid, in yellow *Letharia* species, are definite poisons. So I quickly forgot all

about it.

Recently, I was completing my historical study of H.E. Hasse at New York Botanical Gardens, which received part of his herbarium in 1906 (Knudsen 2010). Leafing through a herbarium folder, I came across a collection of *Acarospora socialis* from Arizona collected by F.R. Lipp on Baboquivari Peak on the Papago Indian Reservation at 2,300 feet elevation on basalt. The label read: Used by Papagos Indians in love magic---has a hypnotic attractant effect on women; also used for luck in hunting and gambling.

Now we all need a little luck in love, hunting, and gambling.

I smiled.

A little later in the day I got an email from a lichenologist in Europe, apologizing to me for being late on his part of a project, because he had just had a rough week and his girl friend had broke up with him.

I told him about the use of *Acarospora socialis* in love magic. I offered to collect him a bag of it when I got back to California. It grows behind my house in the Menifee Hills.

He said he would think about it.

He sounded interested.

Bronx, New York March, 2011

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Arrhenia chlorocyanea (*Omphalina chlorocyanea*) along a trail in the Mima Mounds Area in Washington.
 Photography by Jim Riley.

***Ramalina fraxinea* (L.) Ach. in San Francisco Bay**

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In October of 1998 my late husband Richard Doell, his daughter Shirley and I took a sailing trip to Redwood City at the southern end of San Francisco Bay. Once there, we docked the boat, got into the dinghy, and went exploring in the environs of Redwood City Harbor, in an area where there were several old wooden structures, mostly connected to the walkways which provided access to various pieces of harbor equipment, some of them abandoned.

As we slowly rowed along in this area we could not help but notice some remarkable lichens growing on the old wood. The thalli were a good six inches long and two inches wide, rugose and roughly channeled lengthwise, with apothecia the color of the thallus scattered about.

For reasons which remain a mystery to me, we did not immediately photograph these remarkable specimens, but did collect one for eventual determination. This last occurred soon after, before I even got out the microscopes, chemicals, utensils etc. to do so. At a gathering of visiting lichenologists in Berkeley my mystery lichen was immediately identified by Scott La Greca as being *Ramalina fraxinea* (L.)Ach., a European lichen which may have been carried over here in the ballast of a freighter and then pumped out into the harbor at Redwood City.



Figure 1: *Ramalina fraxinea* dried specimen. Photography by Irene Hightower.

With the vital information of the genus and species of this lichen already at hand, the next step was to check the literature. This led me onto a circuitous path, based on the fact that this was a European species of lichen. At hand were two German lichen books, which seemed like the place to start: "Die Flechten Baden-

Württemberg," Volume 2, 1995, the first large lichen book with colored photographs, by Volkmar Wirth; and the earlier (1969) "Schlüssel Europäischer Flechten" by J. Poelt.

Also at hand were the British lichen books: "The Lichen Flora of Great Britain & Ireland", a British Lichen Society publication dated 1992, and Frank Dobson's "Lichens" (2000). Then finally the American lichen studies edited by Tom Nash under the title "Lichen Flora of the Greater Sonoran Desert Region" Volumes 2, 2004, and 3, 2007.

What they all agree on is the general aspect of *Ramalina fraxinea*. Quoting largely from the 1992 British book, the thallus is up to 20 (- 30) cm. long, more or less pendent, coarsely tufted, grey-green or olive to green-black, branches to 3cm wide, flattened, twisted, tapering towards base and apices, flat or commonly more or less channeled, often with an uneven, longitudinally and reticulately wrinkled surface, apothecia usually frequent, marginal or laminal; disc cup-like,

becoming flat or convex. Ascospores kidney shaped. One thing all these reports agree on is that the spores are kidney shaped, also described as reniform, or curved. Another generally accepted characteristic of this lichen is that lichen products were not detected by thin layer chromatography.

Briefly put, this is a very unusual looking lichen, as can be seen in the accompanying photo (Figure 1), which unfortunately shows the lichen as the specimen now looks, shriveled and changed in color. The Wirth and Dobson books mentioned above both have good photos showing how this lichen looks when fresh. The experts agree that there is quite a variety in the size of *Ramalina fraxinea*. Poelt refers to a dwarf form, and Dobson to poorly developed specimens (Figure 2). The smaller forms appear to be much more common than the larger ones, at least in the Bay Area. *Ramalina fraxinea* is generally thought of as an old world lichen repeatedly cited from California. However, Riefner, Bowler and Ryan reported in 1995 that during their studies of the genus *Ramalina* they found this name to be commonly misapplied. According to them, in California *R. fraxinea* is apparently coastal and rare.

Returning to the Doell studies of *Ramalina fraxinea* in San Francisco Bay, we traveled to Redwood City Harbor in 2006 to see how that species was doing, and to our dismay, even though we went back to the area we had visited before, the large thalli of *R. fraxinea* were no longer there. All we could find were the smaller thalli of what Poelt referred to as the dwarf form, and Dobson referred to as poorly

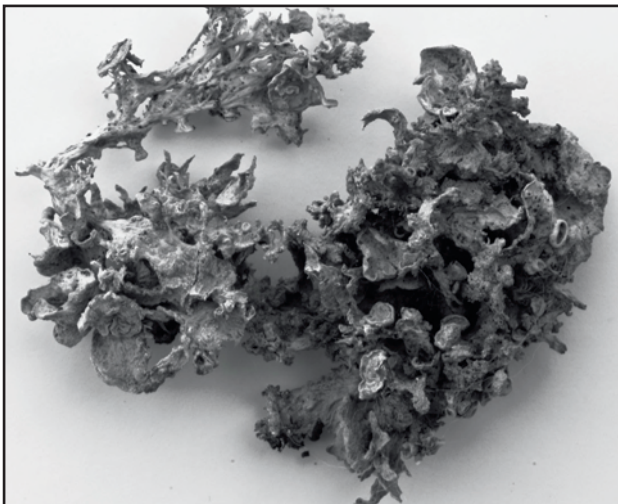


Figure 2: Dwarf form of *Ramalina fraxinea*.
Photography by Irene Hightower.

developed specimens and which were identified by their distinctive irregular thalli, and their reniform spores. (Figure 2).

Now we turn back to May 12, 2002, when CALS had a field trip to Brook's Island, right off the coast at Richmond harbor and part of the East Bay Regional Parks. In our walk along the shore on the western side of the island I found another of the small form of *Ramalina fraxinea*, but not one of the larger ones. Finally, on October 16, 2010, on a return trip to Brooks Island, I found the specimen in Figure 3, which has the color and the twisted, uneven surface, the scattered apothecia and the curved spores of *R. fraxinea*, but the thalli are still only two to three inches tall, and a half inch wide at most. There is always the possibility that these thalli might grow into something larger in the coming years, but at this point, whether the larger form of this lichen still exists in San Francisco Bay remains a mystery. There are, however, lots more places to look for it.

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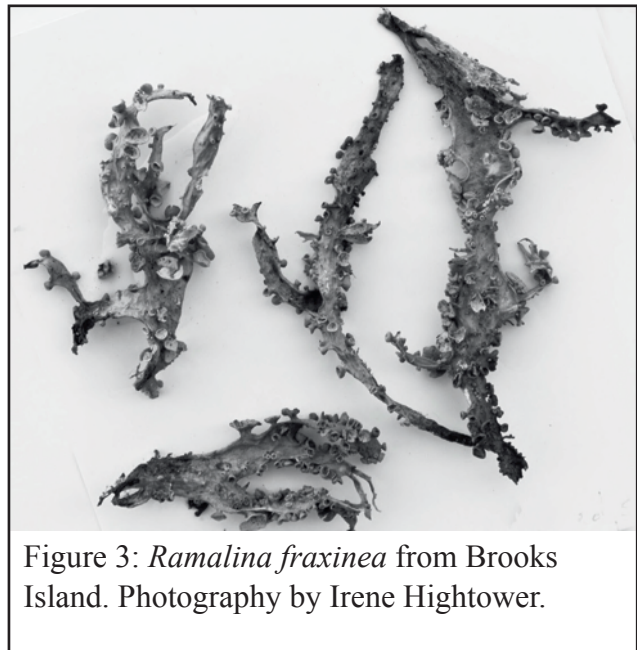


Figure 3: *Ramalina fraxinea* from Brooks Island. Photography by Irene Hightower.

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The Mysteries of the Genus *Leptogium* Workshop

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On the first weekend in April, lichenologists from Central California to Northern Oregon were treated to an illumination of the mysteries of the genus *Leptogium* at a workshop hosted by the Cryptogam Biodiversity Observatory at Southern Oregon University in Ashland, Oregon. The workshop was conducted by Dr. Daphne Stone. She is one of the regions top lichenologists and has done extensive research over the past six years clarifying the distinctions between the difficult to distinguish *Leptogium* species. The workshop was attended by nine botanical consultants, two BLM botanists, two Forest Service botanists, one graduate student at Oregon State University, and a botanist at the Academy of Science Museum in San Francisco.

The workshop included lectures broken

into groups of similar species (ie. large epiphytes, small isidiate epiphytes, rock dwellers, etc.). These presentations were interspersed with opportunities to work through personal collections, review Dr. Stones extensive collections, and practice making cross sections and observing differences in species. The workshop also included a field trip to a lichen rich mixed oak/conifer woodland in the Cascade-Siskiyou National Monument. She gave each participant a folder of extensive reference information including the slides from her presentations, copied to each persons thumb drive. An informal and congenial atmosphere was present throughout the weekend as participants asked questions, contributed anecdotes from their experiences, and shared their observations with other participants.

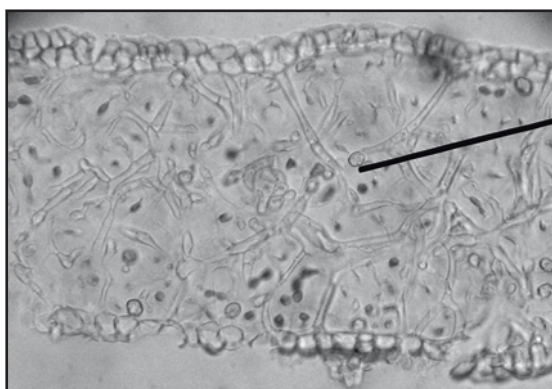


Figure 1. Cross section of *Leptogium tacomae* showing distinctive "chicken wire" appearance of medullary hyphae. Photography by Daphne Stone.

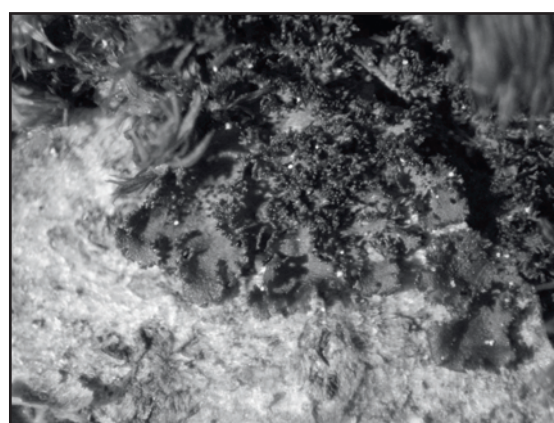


Figure 2. *Leptogium siskiyouensis* from the Butte Falls area, Jackson Co. OR. Photography by John Villella.

Dr. Stone's presentations included several photos of each species including photos of thallus lobe cross sections taken through a compound microscope (Figure 1). She developed the technique of using the patterns formed by hyphae in the medulla to distinguish *Leptogium* species. This has made an important contribution to understanding the taxonomy of this difficult group and provides a way to distinguish otherwise very similar species.

One of the major benefits of this workshop was the opportunity for botanists to work through previously unidentified collections, and this yielded some very important identifications. In addition to the species discussed below several specimens are either undescribed species or unknown from our flora and are currently being studied.

Some other valuable identifications included three regionally rare species. *Leptogium siskiyouensis* (Figure 2) is a recently described rare species that is thought to be endemic to northern California and southern Oregon (Stone and Ruchty 2006). It is currently known from only six small areas, Jackson and Josephine Counties in Oregon, and Mad Ridge and Weaverville in Northern California. This lichen was found in the collection boxes of three participants adding to the still emerging knowledge of this species distribution. *L. plicatile* (Figure 3) is a rare species in northern California and Oregon occurring on calcareous seeps, and one new collection was confirmed during the workshop. Three collections were identified as *L. platynum* (Figure 4), another uncommon but widespread species associated with

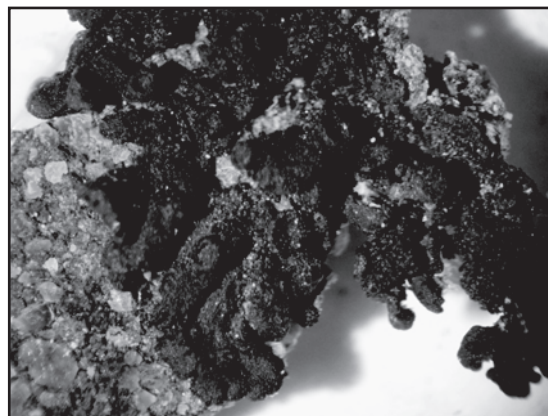


Figure 3. *Leptogium plicatile*.
Photography by John Villella.

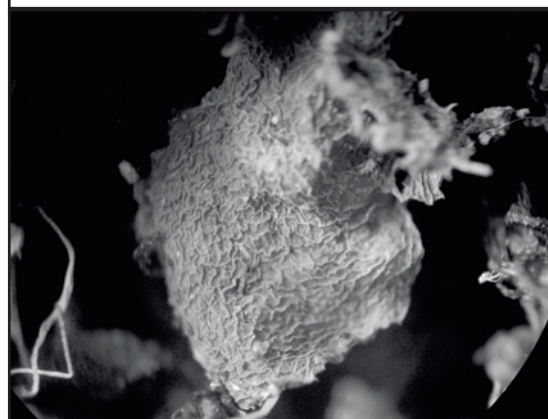


Figure 4. *Leptogium platynum* lobe showing distinctive cortical wrinkles.
Photography by John Villella.

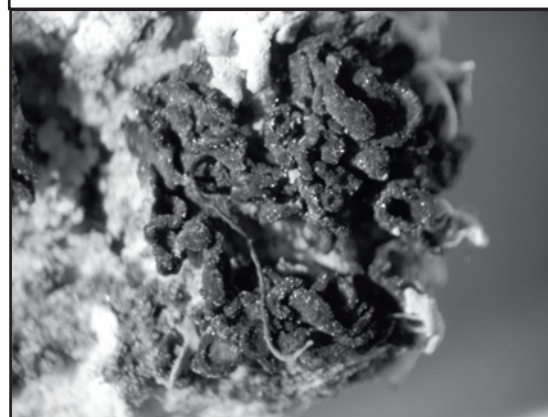


Figure 5. *Collema quadrifidum*, confirmed for the Applegate watershed. Photography by John Villella.

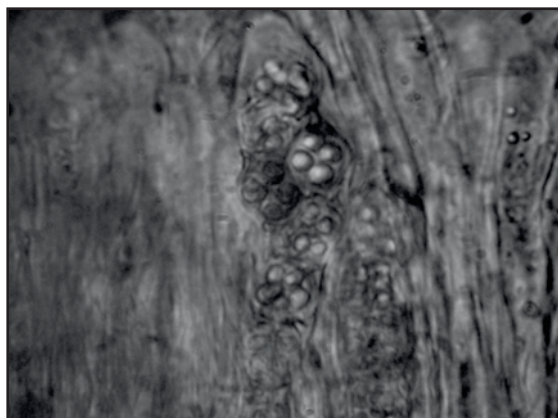


Figure 6. Square spores of *Collema quadrifidum* in asci. Photography by John Villella.

seeps.

The workshop also included a peek into *Leptogium*'s sister genus, *Collema*. Two workshop participants determined that two previously unidentified collections were *Collema quadrifidum* (Figure 5). This is another recently described species with only a handful of documented collections, ranging from California's Trinity Mountains in the south to coastal British Columbia in the north (Stone and McCune 2010). This species is distinguished among local epiphytic *Collema* by its diminutive size, subparaplectenchymatous proper margin, and square spores (Figure 6). The fieldtrip to Cascade-Siskiyou National Monument yielded two more observations of this rare species in an area near where the species was collected during the 2002 NW Lichenologist Certification Exam.

The field trip also allowed a look at several epiphytic and rock dwelling species in this beautiful area protected for its biodiversity. Species observed here included: *Collema nigrescens* /*curtisporum*, *C. furfuracea*, *C.*

quadrifidum, *Leptogium lichenoides* group, *L. teretiunculum*, *L. cellulorum*, *L. palmatum*, and *L. pseudofurfuraceum*.

The workshop was a wonderful opportunity for agency botanists, consultants, and students to gain the skills, knowledge, and experience necessary to work with this difficult but rewarding group of lichens. The Cryptogam Biodiversity Observatory at Southern Oregon University welcomes the opportunity to host workshops on lichens and bryophytes (figure 7).

Anyone interested in proposing a workshop should contact Dr. Steven Jessup (jessup@sou.edu), Associate Professor of Botany at Southern Oregon University.

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Figure 7. Leptogiophiles gather to scratch their heads together. Photography by John Villella.

Lichen Questions and Answers

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Over the years we have had a question and answer article in the Bulletin, and we have handed out Lichen Frequently Asked Questions sheets at the fungus fair and other public events. Recently Tom Carlberg and Shelly Benson gave an introductory lichen presentation for the staff of the Presidio of San Francisco at Fort Cronkhite where the attendees asked many great questions. Here are some questions and answers especially inspired from that workshop. Look for part two to this article in the coming Bulletin as not all the questions could be included here. Part two will include questions on cyanolichens, reproduction, and chemistry.

Q. How fast do lichens grow and how long do they live?

A. Generally, lichens are slow growers with growth rates ranging from 1mm/year (*Rhizocarpon geographicum*, the map lichen) to approximately 10cm/year (*Ramalina menziesii*, lace lichen). Species found in arctic/alpine or desert areas have much slower growth rates than species found in optimal habitats such as coastal-influenced regions. Lichen growth occurs in spurts when growing conditions are suitable due to the amount of light and water available. Lichens become dormant when growing conditions deteriorate. Some specimens have been found that are over 1,000 years old.

Q. Are there 'seasons' for lichens as there are for flowering plants?

A. Not particularly. Lichens are typically quite slow growing and persistent where they become established. Perhaps they can be more easily observed in times of the year when other plants are more dormant, but they are 'always' there. Quite often after a rain they look very different and some species may be almost uncharacteristic and unrecognizable after getting wet compared with what they look like dry. A field of *Cladonia* on the ground can be nearly unnoticeable and easily crunched underfoot when dry but more noticeable, flexible and springy when wet. Many lichens are unusually green when wet because the protective cortex, which is dull and gray when dry, becomes more transparent and allows us to see the green alga underneath. *Lobaria* is a spectacular example of this. Additionally, shriveled and dry gelatinous lichens become unusually plump and gelatinous and more noticeable when wet. Apothecial colors may change also.

Q. Is Spanish moss a lichen?

A. Spanish moss is technically not a moss, nor a lichen. What is more commonly called Spanish moss in the southeast is a bromeliad, a flowering plant more related to pineapples. In our area, pendulous lichens that hang in trees are often (incorrectly) called Spanish moss; these

include *Ramalina menziesii*, *Usnea*, and *Alectoria*.

Q. Does anything look like a lichen that is really not a lichen?

A. Yes, you could be tricked by several things. Some non-lichenized fungi (fungi without an algal partner) look very much like lichens and actually grow on lichens. The term for this type of fungi is lichenicolous fungi. Some free-living algae may also be confused as lichen. At first glance, the bright orange *Trentepohlia* algae on coastal cliffs and trees may look like a lichen, but closer examination shows it to be a fibrous, furry structure unlike a lichen. *Trentepohlia* is a relatively common photobiont found in lichens along the immediate coast in California.

Q. What are the main growth forms of lichens?

A. This is the perennial question for beginners. There are five main lichen growth forms - foliose, fruticose, crustose, squamulose, and leprose. These terms are used to describe the general morphology of lichens but have no relevance for taxonomic classification.

FOLILOSE lichens grow loosely attached to their substrate and are leafy in appearance. The upper surface of the lichen looks noticeably different than the lower surface, which is usually attached to the substrate at multiple points by anchoring structures called rhizines.

FRUTICOSE lichens can be long and dangling or short and shrubby in stature. Either way, there is no obvious upper or lower surface to the lichen, which is

usually attached to the substrate at a single point.

CRUSTOSE lichens are crust-like; they have a low profile and grow in close contact with their substrate. Some actually grow within the upper layer of the substrate. In the case of a rock substrate, the fungal hyphae grow between the grains of the rock. As a result, crustose lichens typically cannot be removed without taking some of the substrate along with the lichen.

SQUAMULOUS lichens are made up of many small scale-like lobes.

LEPROSE lichens are entirely powdery with almost no other structure. Some people like to call this group dustose lichens as a play on the term crustose.

Q. Do all the species in a particular lichen genus have the same growth form (e.g. are all *Ramalina* species fruticose, are all *Lobaria* species foliose)?

A. This is mostly true, however there are exceptions. For example, the genus *Caloplaca* is overwhelmingly crustose, yet *Caloplaca coralloides* is a fruticose species (albeit a very tiny fruticose species).

Q. Are lichens specific to certain substrates?

A. Most lichens are particular as to the type of substrate they live on, with some species being better generalists than others. Some lichens are found only on a specific type of rock (calcareous, siliceous, sandstone, granite, etc.) or on bark of a certain type of tree (deciduous trees with smooth bark, conifers, oak, chaparral shrubs, etc.).

Q. What are pseudocyphellae as opposed to cyphellae?

A. Both terms refer to openings in the cortex of lichens. However, the key difference is that cyphellae are lined with differentiated cells, whereas pseudocyphellae are not. Cyphellae are crater-like pores found on the lower surface of lichens in the genus *Sticta*. Pseudocyphellae can look like cracks, pin holes, or pock marks on either the upper or lower cortex of lichens in many different genera.

Q. What is the function of pseudocyphellae?

A. Pseudocyphellae are believed to act as pathways for more efficient gas exchange across the cortex.

Q. What is the basic anatomy of a lichen?

A. Most lichens are composed of distinct layers; they are stratified. A cross section through a typical foliose lichen shows the following layers from top to bottom: the UPPER CORTEX is a thin, protective skin composed of fungal hyphae; the PHOTOBIONT LAYER contains the photobiont, either green algal cells or cyanobacteria; the MEDULLA is the thickest layer, composed of loosely packed fungal hyphae; finally, the LOWER CORTEX, the protective skin covering the lower surface of the lichen. You will find variation on this theme as you explore the diversity of lichens in our region. For example, some lichens don't have a cortex, *Usnea* has a tough central chord in the medular region, and many

gelatinous lichens are not stratified; the photobiont cells and fungal hyphae are all mixed together.

Q. What happens when lichens dry out?

A. Lichens are survivors. They have the ability to dry out and enter a state of dormancy where biological activity stops. The lichens are not dead, just waiting for moisture to come again. When re-hydrated, biological activity kicks into gear and the photobiont begins photosynthesizing. An 85 year old lichen specimen stored in the Helsinki herbarium was re-hydrated and the algae was still alive!

Q. What makes a lichen such a unique organism?

A. Lichens have numerous qualities that make them unique. One of the most outstanding qualities is that lichens are composite organisms, composed of representatives from two and sometimes three different kingdoms (a fungus and an alga and/or a cyanobacterium). Additionally, the result of lichenization is that the lichen looks nothing like its individual components. There is also a lot to lichens that we don't understand yet, which makes these organisms intriguing. For example, we don't really know what is involved at that magic point of lichenization when the fungus and photobiont come together and join to form a lichen. In the lab, lichenologists have taken lichens apart to examine the fungus and photobiont separately; however, recombining them to create the lichen again is not always successful.

Q. Is the San Francisco Bay Area a particularly lichenized area?

A. There are many species here, many perhaps that have not yet been described. The number of lichens in heavily populated areas is low, but much of the Bay Area is coastal and semi-rural where lichens thrive on the clean air and moisture. As for lichen studies in the area, Herre published his seminal "Lichen flora of the Santa Cruz Peninsula" in 1910. Marin and Sonoma county have been relatively better studied most recently by the late Judy and Ron Robertson (and before that by Darrell Wright), but many areas have not been thoroughly investigated.

Q. What are good references for learning lichen terminology?

A. The California Lichen Society's website californialichens.org, now has a glossary of lichen terminology (originally written by Bruce Ryan). Also there is a wonderful color illustrated glossary in the spiral-bound book "New Zealand lichens: checklist, key, and glossary" by Malcolm and Galloway.

Q. What are some good books on lichens?

A. Brodo - "Lichens of North America" is nearly our 'bible' with fantastic photos and amazing coverage for California. There is McCune and Geiser - "Macrolichens of the Pacific Northwest", more economical at \$35 and particularly useful in northern California. The three volume "Lichen Flora of the Greater Sonoran Desert Region" by Nash et al. is also excellent

and rather comprehensive. Hale and Cole "California Lichens" is getting difficult to find and tends to already be somewhat out of date, but smaller and useful for beginners. The California Lichen Society offers a nice pocket guide - "A CALS miniguide to some common California lichens". In addition to books, there are many good references online these days, for instance Bruce McCune's "Key to the Lichen Genera of the Pacific Northwest" <<http://people.oregonstate.edu/~mccuneb/pnw.PDF>> and "Usnea in the Pacific Northwest" <<http://people.oregonstate.edu/~mccuneb/Usnea.PDF>>. Trevor Goward's excellent "Lichens of British Columbia. Illustrated Keys" for foliose, squamulose and fruticose species at <<http://www.geog.ubc.ca/biodiversity/eflora/LichensofBCGoward.html>>; these, and other online keys are quite useful here in the Bay Area and California.

Q. Where can I obtain the latest California lichens checklist?

A. It is easiest to find links to this at our website <<http://californialichens.org>>. For instance the link to the Tucker/Ryan California lichens checklist in the online publication Constanca <<http://ucjeps.berkeley.edu/constanca/84/>> is there, as well as a link to Esslinger's checklist of North American lichens <<http://www.ndsu.edu/pubweb/~esslinge/chcklst/chcklst7.htm>>. You can find these and many other resources at <<http://californialichens.org>>.

News and Notes

Educational Grant Awards for 2011

The Educational Grants Committee is pleased to announce that two members were awarded educational grants during the current grants cycle. Gajendra Shrestha is a PhD student at Brigham Young University and was awarded an educational grant for his proposal "Antibiotic Activity of Two Fruticose California Lichens *Usnea lapponica* and *Ramalina menziesii*". Gajendra will be screening crude extracts of these lichens against various pathogenic bacteria to test their antibiotic properties. A second objective of his study involves isolating and identifying specific secondary metabolites present in these species. Seth

Shteir received an award to purchase supplies for The Joshua Tree Climate Summit to be held May 2011. During this Summit 25-40 High School students from Morongo Valley and Coachella Valley will learn about climate change from Joshua Tree National Park's Resources Staff. Then, students will collect lichen data in the Black Rock Canyon based upon observation and drawings. The data will be compiled by Joshua Tree National Park's Resources Staff and used as a way to determine if climate change is affecting the lichens present in this National Park.

I would like to personally thank the members of the Education Committee who read and evaluate the proposals we receive. Shirley Tucker, Jennifer Riddell,



Gajendra Shrestha recieved a 2011 CALS educational grant award to support his research on the antibiotic properties of two California lichens.

and Don Reynolds have consistently provided prompt and insightful feedback on these proposals. As a committee, we would also like to thank our members for their generous contributions to the educational grants fund. CALS has been able to offer two educational grants each year for the last three years consecutively. This would not be possible without the continued support from our members. We look forward to funding more research opportunities in the future. If you know of anyone working on California lichens who these grants could assist, please let them know about their availability. The guidelines for these grants are posted in

this Bulletin and online at californialichens.org.

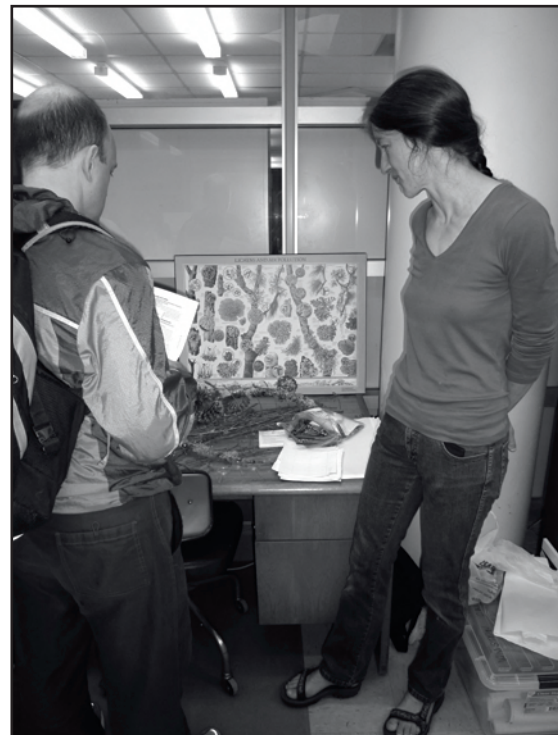
~ Erin P. Martin

CAL Day at the Jepson Herbarium

On April 16th, 2011, CALS again had a lichen display at CAL Day at the Jepson Herbarium, University of California, Berkeley. CALS members Janet Doell, Doris Baltzo, Nancy Hillyard, Hanna Mesraty, Miko Nadel, Rikke Naesborg, Bill Hill, Oshara Waago, and Irene Winston helped with our display and answered questions. We gave away lichen samples, sold posters, and had posters with a photo history of CALS including our



2011 CALS educational grant recipient Seth Shteir at Kelso Dunes. Seth received funding to purchase hand lens for high school students to use studying lichens at Joshua Tree National Monument.



Viewing lichens on display by CALS at the Jepson Herbarium. Photography by Bill Hill.

workshops and fieldtrips; there was a dissecting microscope set up to show lichens close up, and an array of specimens to see as well as a children's table materials, copies of Trevor Goward's enlivenment essays, posters of lichens and pollution, and lichens and dyes. Doves of visitors passed by our display and many were excited to learn about lichens.

~ Bill Hill and Irene Winston

Northern California Botanists Conference 2011

Several CALS members attended the

Northern California Botanists' Symposium in Chico January 10-12, 2011. Tom Carlberg hosted a conference session on lichens which featured presentations from four California and Oregon lichenologists. Justin Shaffer (Santa Cruz) presented research on antifungal actions of lichen acids with a focus on polar compounds that are soluble in water. Eric Peterson (Weaverville) presented research on lichen biogeography and differences between lichen and plant dispersal patterns. Sarah Jovan (Portland) presented research on lichen air pollution monitoring and the impact of air pollution on California



Irene Winston at the California Lichen Society booth during CAL Day. Photography by Bill Hill.

lichen communities. Finally, John Villella (Ashland) gave an overview of rare lichens of conservation concern in California. The following day Tom Carlberg led a field trip to investigate the rich saxicolous lichen communities in upper Bidwell Park, an expansive city park that extends into the foothills above Chico. Cross pollination between lichenologists and vascular plant botanists was a highlight of this conference, and we left inspired and well-fed.

~ John Villella



Nancy Hillyard showing visitors lichens under the microscope during CAL Day. Photography by Bill Hill.

Spring and Fall versus Summer and Winter Issues of The Bulletin

Last year, we moved the Bulletin issue dates to the Spring and the Fall because the timing worked better for those who were working on the Bulletin. Because we now have a new copy editor, whose work schedule is very busy during those times, we are moving back to the normal issue times. The Bulletin will be issued during the Summer and the Winter instead of during the Spring and Fall. This change will not result in any missed issues. Thanks for your understanding.

Check out our updated website!

The CALS website has been updated by our new webmaster Eric Peterson. The upcoming events section is now current and activities of the Society are posted regularly. In addition, all .pdf copies of The Bulletin up to 2009 issues are now available online. The website includes links to several resources, membership information, and conservation data. Please take a look at our new site: www.californialichens.org.



CALS Research/Educational Grants Program

CALS offers small grants to support research or education pertaining to lichens in California. No geographical constraints are placed on grantees or their associated institutions. The Research/Educational Grants committee administers the grants program, with grants awarded to an individual only once during the duration of a project.

Grant Applicants should submit a proposal containing the following information:

1. Title of the project, applicant's name, address, phone number, email address, and date submitted.
2. Estimated time frame for project
3. Description of the project: outline the 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.
4. Description of the final product: We ask you to submit an article to the CALS Bulletin, based on dissertation, thesis, or other work.
5. 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, living expenses, and supplies. CALS does not approve grants for outright purchase of high-end items such as computers, software, machinery, or for clothing.

6. Academic status: state whether you are a graduate student or an undergraduate student. CALS grants are available to non-students conducting research in areas related to California lichens. CALS grants are available to individuals only and will not be issued to institutions.
7. 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 emailed to the chairperson of the education committee, enclosed with the application, or mailed separately to the CALS Grants Committee Chair.
8. Your signature, as the person performing the project and the one responsible for dispersing the funds.

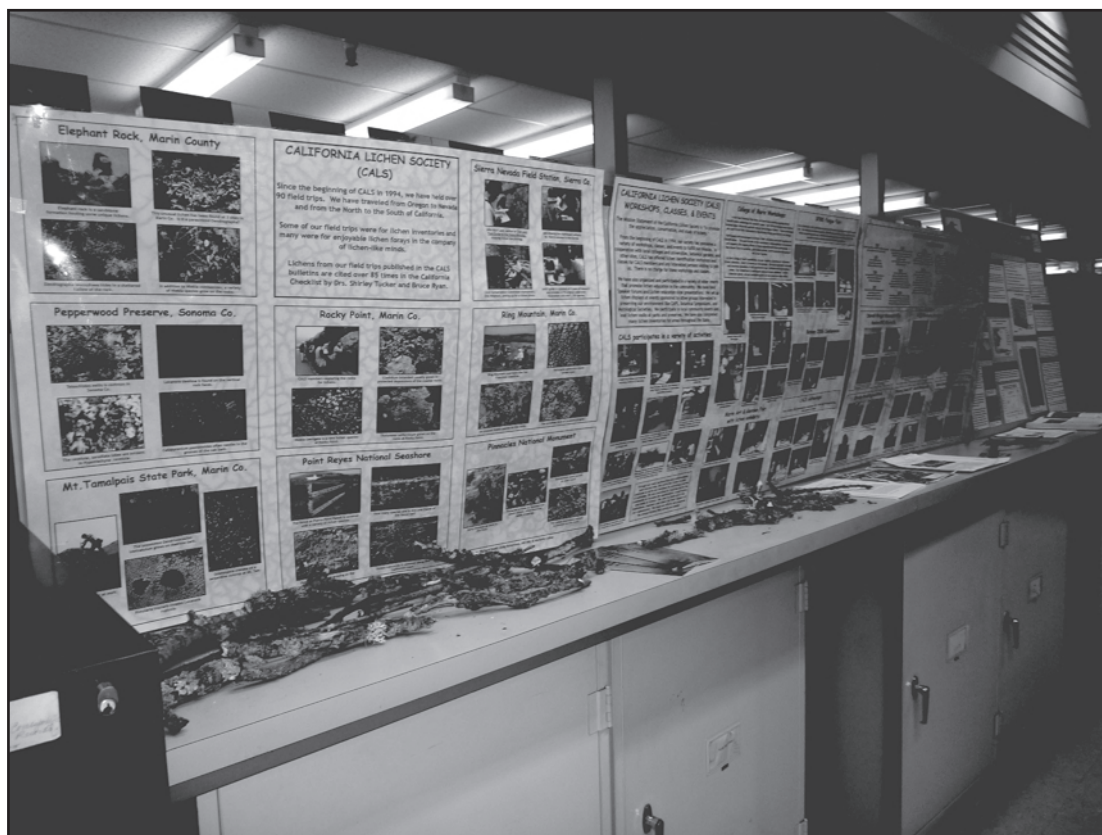
The proposal should be brief and concise. The research/education grants committee brings its recommendations for funding to the CALS Board of Directors, and will notify applicants as soon as possible of approval or denial. Members of the education committee review grant proposals once or twice a year based on: completeness, technical quality, consistency with CALS goals, intended use of funds, and likelihood of completion. Grant proposals received

by October 1, 2011, will be considered for the current grant cycle. CALS typically offers 2 grants in the amounts of \$500 and \$750 each 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 CALS Bulletin.
3. Submit any relevant rare lichen data to California Natural Diversity Data Base using NDDDB's field survey forms.
4. Periodically update the research/education committee of progress on the project.

How to submit an application: Please email submissions or questions to the committee chairperson by Oct. 1, 2011. This year the committee chairperson is Erin Martin. Her email is shastalichens@gmail.com. You are encouraged to submit materials electronically. If this is not an option you can mail a hard copy to Erin Martin, University of Portland, Department of Biology – MSC#68, 5000 N. Willamette Blvd., Portland, OR 97203.



The California Lichen Society Display at the Jepson Herbarium during CALS day. Photography by Bill Hill.

Upcoming Events

College of Marin Lichen Identification Workshops

We have a regular lichen identification workshop at College of Marin on the 2nd and 4th Friday of the month (unless otherwise announced). Bring your specimens to identify or join in to work with others on theirs. Directions to Kentfield Campus of College of Marin: see also From Highway 101 take Sir Francis Drake Blvd west, turn left at College Ave (7th stoplight) and right into parking lots on right. The science building is the large low one story building with parking underneath. We are in room 191. Best evening free parking is on Kent Ave from the back/left end of the campus parking.

Tilden Botanical Garden Workshops

This is a 'regular' lichen study group meeting on the second Saturday of the month (unless otherwise announced). We variously tour the Botanic Garden to observe and identify the lichens there, and also meet at the visitor center for a lichen identification workshop. Bring specimens you would like us to work on or just join us in the learning. Everyone is welcome. There is free parking and admission is free at the Tilden Botanic Garden. Directions to the Garden:

<http://www.nativeplants.org/directions.htm>
l

RSVP to Irene Winston:
irenewinston@comcast.net



Cathedral Cliffs. Photography by Scot Loring.



Soda Mountain Wilderness Area. Photography by Scot Loring.

NW Lichenologists - Cathedral Cliffs / Soda Mt Wilderness Outing

Scot Loring will lead us on a trip to Cathedral Cliffs and Soda Mountain Wilderness, on the weekend of September 10-11, 2011. This is a fascinating area on the Oregon - California border that has been explored for lichens by only a few people (mainly Scot).

Northwest Lichenologists has been granted a unique access opportunity for a lichen foray into Soda Mountain Wilderness. The Medford BLM, in coordination with private landowners, has given us permission to drive into a small sliver of land excluded from the wilderness but located centrally within it. This drive is in through California, where

the BLM previously had little to no vehicular access. This arrangement will likely not be available in the future. Only a few roads come close to the wilderness through California, all of them through private land or otherwise off-limits to the public for vehicles. Reaching the wilderness through California is normally done on foot via long hikes each direction just to reach the boundary. Collection permits have been obtained. Permission for vehicular camping has also been granted, which normally would not be possible in this particular area.

Soda Mountain Wilderness is located in southwestern Oregon east of Ashland, between highway 66 and the California state line. Found within an area often

referred to as the Klamath Knot, the wilderness displays convergence of several eco-regions. There is a wide diversity of plant communities including meadows, oak woodlands, juniper savannas, riparian areas, shrub communities, mixed hardwood/conifer forests, etc.

Itinerary:

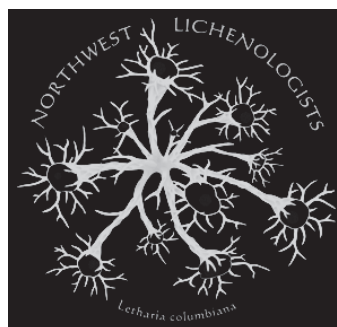
- September 9: meet in Ashland, Oregon at 1:00pm; carpool into the wilderness area; set up camp; conduct short collection hikes nearby.

- September 10: hike to Cathedral Cliffs. This is not a short hike (several miles each direction) but due to our access point, is done almost entirely along an easily walked road (closed to all vehicles) with very little elevation change -- access points from the north in Oregon involve much more elevation change. The hike takes us through the many plant communities of the wilderness area, offering numerous collection opportunities. The cliffs themselves are quite extensive and have a calcareous component.

- September 11: collection opportunities nearby; break camp; depart.

Other details: Please contact Scot gniroltocs@hotmail.com, if you wish to attend. Due to road conditions, 4x4 vehicles with high clearance are strongly recommended if not required. We do not currently have a limit on the number of vehicles, but fewer would be better to minimize impacts to the roads. If you have such a vehicle that you are willing to use for carpooling, please let Scot know. Due to passage through multiple locked gates, we must enter and leave as a single group.

Maps, photos of the area, and more info are in the May 2011 NWL newsletter. <http://home.comcast.net/~nwlichens/2011MayNWLnews.pdf>



**2011 NWL Certification --
Macrolichens west of the Cascade Crest**

Sat, Sept 17 - Sun Sept 18, 2011. Drift Creek Camp, Oregon, near Lincoln City. As a byproduct of our certification, we will be assisting the Drift Creek Nature Center in their inventory of local biodiversity.

Examiner: Bruce McCune

Our most recent certification was in October, 2009 at the Siskiyou Field Institute, Deer Creek Center. In 2008 the NWL Board decided that Certification exams will be offered only every other year. Participants may want to arrive Friday night, Sept. 16. Please let us know if you will be arriving Friday or Saturday. The field part of the exam will take place near Drift Creek Camp. This is a great opportunity to test your knowledge of our lichen flora and our rare species. Even if you are not ready to be certified, this can be a great learning experience, getting feedback on how well you can do the field work and learning your weak spots and your strong spots. The exam is our effort to provide lichenologists a standardized

way of demonstrating competency in the Pacific Northwest. It consists of two parts. Part one is a written exam covering knowledge of local species and distribution and habitat of listed species. Part two is collection on a sample plot, then identification of that collection. Examples of sample questions for the written exam as well as a list of listed species is posted on our website. This list is currently under revision. A new list will be posted in plenty of time before the certification.

For more information, email the examiner, Bruce McCune or the NWL secretary/treasurer. Reserve your spot by mailing your registration form and a check to: Bruce McCune, NWL Secretary, 1840 NE Seavy Ave, Corvallis, 97330. Checks should be made out to Northwest Lichenologists. Be sure to bring a hand lens and/or dissecting microscope and lamp, along with a power strip. Bring your own tools and, ideally, your own spot test bottles. The examiner will bring some of those, but you can avoid competition for them by bring your own reagents.

Cost: \$100 application fee (must accompany application, does not include accommodations or food). Optional: \$10 fee to return specimens by mail (pay to Examiner directly). Facilities fee to be determined by the venue.

Application: First come first serve; maximum of 20 participants; if fewer than 5 participants register, then the certification will be cancelled for the year. To apply, print the pdf file, fill it out, and mail in.

<http://home.comcast.net/~nwlichens/certif.pdf>

Siskiyou Field Institute - Intermediate Lichens

Date: October 15th - 16th, 2011.
Location: Deer Creek Center, Selma, OR.
Instructor: Daphne Stone, PhD. Tuition: \$100.

This class offers an in-depth look into some of the more challenging local lichen genera, including *Usnea*, *Peltigera*, *Melanelia* (s.l.) and *Bryoria*. Course will include short field trips. Daphne will bring her collections for study – bring some of yours as well! Not recommended for beginning lichenologists - you must be familiar with keying lichens with the McCune book and have worked some independently on these genera. But if your curiosity about lichens has been whetted by one of SFI's Introduction to Lichens classes, this is the class for you! See <http://www.thesfi.org/> for information on The Siskiyou Field Institute.

Lichenology Seminars at the Humboldt Field Research Institute in Steuben, ME.

- Jun 12 – 18: The Lichen Genera *Rhizocarpon*, *Fuscidea*, *Porpidia*, and Other Lecideoid Lichens. Alan Fryday.

- Jul 17 – 23: Lichens and Gravestones. Judy Jacob and Michaela Schmull. Descriptions of seminars may be found at <http://www.eaglehill.us/programs/nhs/nhs-calendar.shtml>. Information on lodging options, meals, and costs may be found at <http://www.eaglehill.us/programs/general/application-info.shtml>. There is an online application form at <http://www.eaglehill.us/programs/general/application-web.shtml>. Syllabi are available for these and many other fine natural history training seminars on diverse topics. For more information, please contact the Humboldt Institute, PO

Box 9, Steuben, ME 04680-0009. 207-546-2821. Fax 207-546-3042. E-mail - <mailto:office@eaglehill.us>. Online general information may be found at <http://www.eaglehill.us>.

International Association of Lichenologists Symposium

The 7th IAL Symposium will take place in Bangkok, Thailand on January 9-13 2012. The topic is Lichens: from Genomes to Ecosystems. For more information please visit the IAL website: <http://www.ial7.ru.ac.th/>.

American Bryological and Lichenological Annual Meeting

The 2011 annual ABLS meeting will take place in Roan Mountain Tennessee on June 20-24. For more information please visit their website at: <http://192.104.39.110/events.html>.

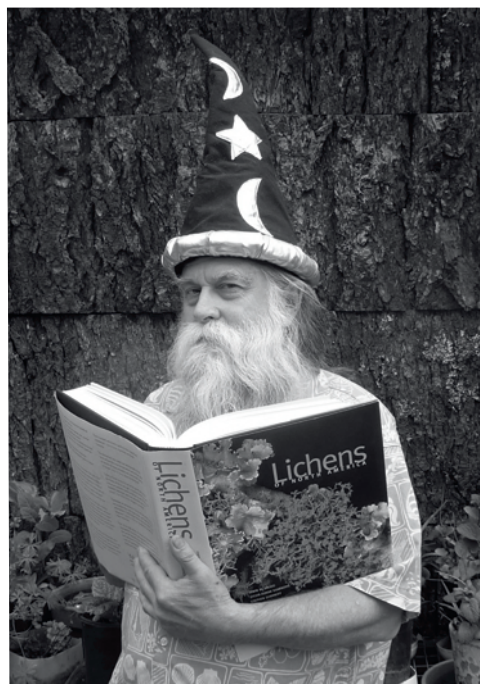


Dibaëis baeomyces in Maine. Photography by Nancy Hillyard. Photo taken when she attended Ernie Brodo's crustose class in 2006.

PRESIDENT'S MESSAGE

Hello again CALS lichenologists and aficionados of *enlichenment* (and thank you Trevor Goward for coining that term)!

Here it is the 17th year of the California Lichen Society and I'm back again as president. Let me wax nostalgic for a moment to remember how we got started on that fateful winter of 1993-1994 when a dozen of us came together on January 29 at the Santa Cruz Mts. cabin of Janet and Richard Doell for our seminal meeting. It followed a lichen exhibit at the Fungus Fair put on by the San Francisco Mycological Society the previous December, where three of us met. In retrospect we had a magical confluence of participants that set an integrated dynamic at our beginning: Janet



Doell who had the foresight to create our existence as a 501c3 federal nonprofit corporation and became our first president; her husband Richard Doell whose passion was photography, and who became our production editor for many years; Darrell Wright who created our Bulletin as its first editor with his thoroughness of self taught scientific investigation and passion for environmental preservation, which made the Bulletin a scientific report AND an outreach for non-academics; Harry Thiers at San Francisco State University who taught so many about lichens and fungi and provided us with a solid stream of expertise and former students - which included Janet and Richard Doell already mentioned, Mona Bourell of CalAcademy, Barbara Lachelt (who became our first Vice President, with her experience as a teacher and mainstay of the original outreach at the Fungus Fair that finally inspired us to 'meet more often' than once a year), and Doris (E.) Baltzo with her knowledge of Usnea and Mt. Diablo. Then there was Charis Bratt who knew every lichenologist on the planet and solidly connected us with that scientific community; and I, Bill Hill, who helped Darrell Wright in the early days and provided much of our original membership list by networking at a previous botany conference in Davis.

CALS is as much about people as it is about lichens. After all, our mission statement is to "promote the appreciation, conservation, and study of lichens". So how do we do it? Quite often the organizational roles of president, vice president, secretary, treasurer, etc. are only a few of the actual ways that things get done. From the beginning we have always been into 'enlichenment' of the general public, and I want to thank our previous Board for continuing our Society in this direction, and also for getting us more connected again with the academic/professional community - with Erin Martin as our president with her background in University teaching, Cheryl Beyer our treasurer and Tom Carlberg our Bulletin editor both

with connections in the Forest Service, and everyone doing networking and outreach via conference participation -- And our student grants program is going strong again.

It has sometimes been a challenge to find people who can take on some of our organizational roles, and to arrange ourselves effectively in those roles. We mourn the loss of some of our most active and productive members, such as Judy and Ron Robertson and before that Richard Doell, and before that Darrell Wright. But we are still here, and perhaps now with a resurgence, despite the various ups and downs and losses that we have endured.

We have tried new things - some worked well, others not so well. We learn with time, and I believe it gets better. Over the years the production of our Bulletin has spread out geographically with editors communicating with each other and with the printer 'remotely' via the internet - and that seems to have worked just fine. We thought we would 'solve' the problem of a distributed Board by holding meetings online with Skype and using a mailing service (Earthclass mail) to receive and distribute the contents of correspondence to appropriate board members. Earthclass mail worked for a while but ended up being too expensive for the volume of mail that we process. So we are back to PO Box 472 in Fairfax which is again locally accessible to our treasurer, president, and even vice president. We moved our membership data recording system into eTapestry, an internet system for non-profits that is thus accessible to board members wherever they are, and after a few stumbles in learning how to use it, we are getting better at it.

So we now have a new Board. Erin Martin maintains continuity now as secretary after being president; Tom Carlberg maintains continuity with his experience; Shelly Benson brings in new energy as vice president; we again have Kathy Faircloth as treasurer with her previous experience and expertise; and I am back as president. And we now have John Villella enthusiastically becoming our Bulletin editor with his background and connections. Eric Peterson, besides being chair of our Conservation Committee, has revived our californialichens.org web presence. Our regular lichen identification workshops continue to help us 'grow' more lichenologists beyond academic circles. Patti Patterson, our previous secretary, has kept our lichen workshops at the College of Marin continuing; and we find Irene Winston essentially creating our (new) workshops at the Botanic Garden of Tilden Regional Parks in Berkeley, as well as stepping in to organize our outreach presence at the Fungus Fair and CALday. I think we have a team!

CALS has sometimes been accused of being San Francisco Bay Area centric, but that is because that is where we began and have the majority of our members. I would be delighted to see more CALS activity elsewhere -- so please take this as 'permission' to get involved and start something up wherever you are. Set a time and place and then please announce it through our website, yahoogroup, and this Bulletin - and people will come. And we are all here to help you spread 'enlichenment'. As I mentioned above, this past January 29th marked the 17th year of CALS. As in nearly all the years that I remember we celebrated at the

clubhouse of the condominium of the Doells, with a fieldtrip in the area followed by our annual meeting including the first meeting of the 'new' board, dinner with birthday cake, annual membership meeting where we talk about our direction with all the members present, and a presentation about some aspect of lichens by one of our members. We religiously have our annual lichen exhibit at our 'birthplace', the San Francisco Mycological Society's *Fungus Fair* on the first weekend of December. And now, more recently we have an exhibit at CAL Day at the Jepson Herbarium at UC Berkeley. These events give greater public exposure to CALS and we always find new members while dazzling people about the wonders of lichens. Drove of people come through with their kids. It gives me great pleasure if we turn on just one budding scientist by showing them how to use a microscope to see lichen details. It is exhausting but satisfying to answer a myriad of questions and see people walk away 'enlichened'.

There have also been outreach workshops to organizations beyond CALS which want to know more about lichens. A perennial in the past has been the California Native Plant Society, but recently Irene Winston and I presented a program for the Berkeley Garden Club, and Tom Carlberg and Shelly Benson did one for the folks of the Presidio. These events, some fieldtrips, student grants, as well as an internet presence via our yahogroup and our californialichens.org are what keep CALS a viable organization. Probably most important of all - for current and new members - is our regular workshops, of which we now have TWO in the San Francisco area: at the College of Marin on the 2nd and 4th Friday evenings of the month, and now also at the Tilden (Regional Parks) Botanic Garden in Berkeley on the 2nd Saturday afternoon of the month. Many of our more capable members began through our workshops. I would like to see workshops help beginners become more adept and confident in their identifications. Through these workshops we are working in various directions to make lichen identification keys more effective. At workshops we work with the difficult parts of existing keys to help beginners (and ourselves!) have more success while winding our way through them. Some are working on getting more effective online keys, and we are considering creating a 'Lichen Finder' key akin to the Glen Keator's 'Tree Finder'.

We need to continue the legacy of our late Judy Robertson with more fieldtrips, revisiting old places (with new people), looking into new places,... and having more workshops with a particular focus, such as the incredible one for crustose lichens by Irwin Brodo at Bodega Bay last February. Enlichenment is happening.

Enjoy!
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Back Cover:

- A. Florida Lichens. Artwork by Angela Mele.
- B. *Usnea rigida* sens. lat.; see article by J. Miller page 1. Photography by Daryl Wright.
- C. *Leptogium siskiyouensis*; see article by J. Clark page 20. Photography by John Villella.
- D. Member submitted photo. A gold mine of lichens found south of Tonopah Nevada off a 4WD road. *Caloplaca ignea* was present. Photography by Fritz Maytag.
- E. *Collema quadrifidum*; see article by J. Clark page 20. Photography by John Villella.
- F. Crater Lake; see article by J. Villella et al. page 5. Photography by Erin P. Martin.
- G. Spores of *Collema quadrifidum*; see article by J. Clark page 20. Photography by John Villella.

