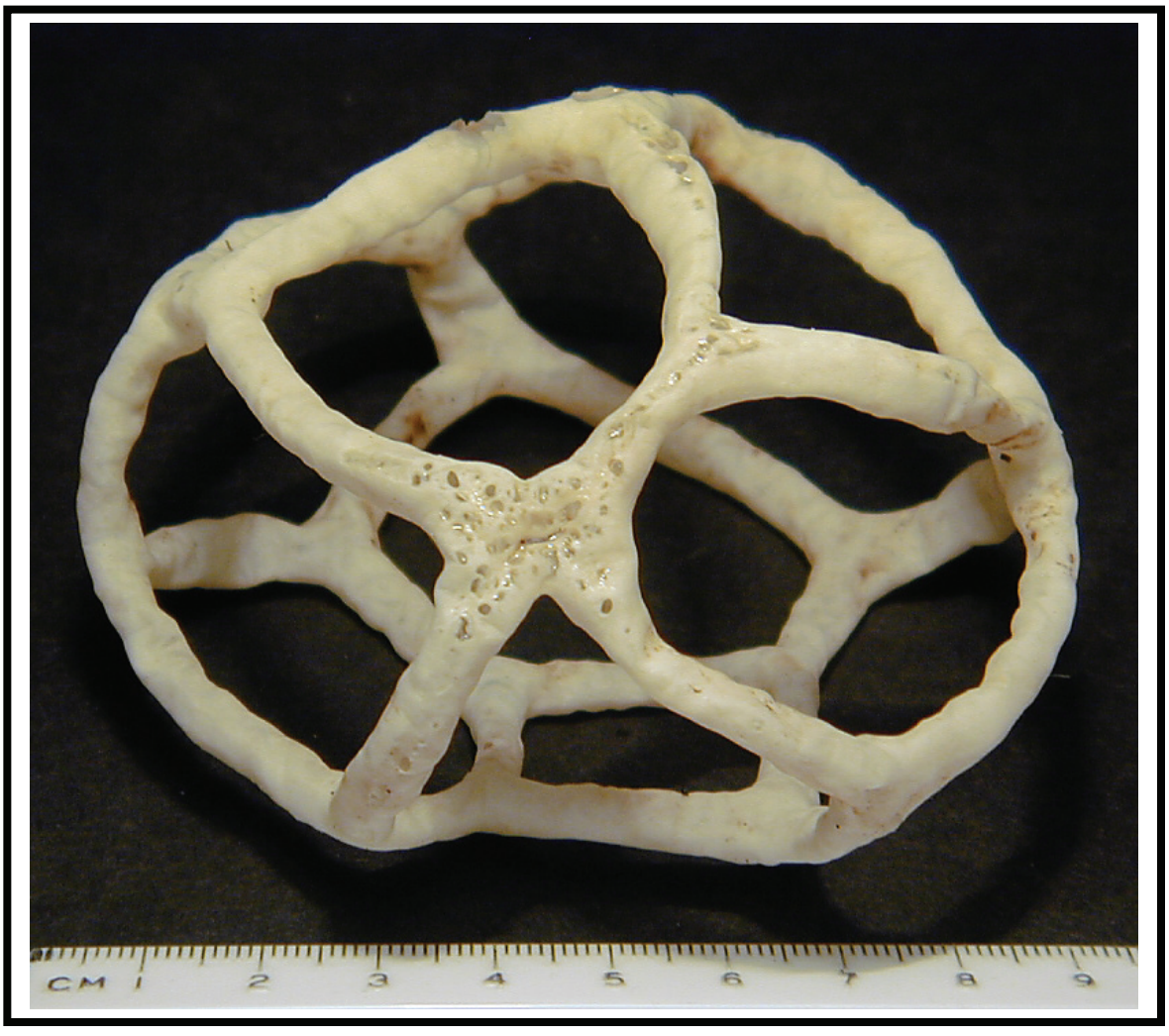
Bulletin

of the

California Lichen Society



Volume 13 No. 2 Winter 2006

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 (in $US per year): Student and fixed income - $10, Regular - $18 ($20 for foreign members), Family - $25, Sponsor and Libraries - $35, Donor - $50, Benefactor - $100 and Life Membership - $500 (one time) payable to the California Lichen Society, P.O. Box 472, Fairfax, CA 94930. Members receive the Bulletin and notices of meetings, field trips, lectures and workshops.

The Bulletin of the California Lichen Society (ISSN 1093-9148) is edited by Tom Carlberg, tcarlberg7@yahoo.com. The Bulletin has a review committee including Larry St. Clair, Shirley Tucker, William Sanders and Richard Moe, and is produced by Eric Peterson. The Bulletin welcomes manuscripts on technical topics in lichenology relating to western North America and on conservation of lichens, as well as news of lichenologists and their activities. The best way to submit manuscripts is by e-mail attachments or on a CD in the format of a major word processor (DOC or RTF preferred). Submit a file without paragraph formatting; do include italics or underlining for scientific names. Figures may be submitted electronically or in hard copy. Figures submitted electronically should provide a resolution of 300 pixels-per-inch (600 minimum for line drawings in JPEG format); hard copy figures may be submitted as line drawings, unmounted black and white glossy photos or 35mm negatives or slides (B&W or color). Email submissions of figures are limited to 10 MB per email, but large files may be split across several emails or other arrangements can be made. Contact the Production Editor, Eric Peterson, at eric@theothersideofthenet.com for details of submitting illustrations or other large files. A review process is followed. Nomenclature follows Esslinger and Egan's 7th Checklist on-line at http://www.ndsu.nodak.edu/instruct/esslinge/chcklst/chcklst7.html. The editors may substitute abbreviations of author's names, as appropriate, from R. K. Brummitt and C. E. Powell, Authors of Plant Names, Royal Botanic Gardens, Kew, 1992. **Instructions to authors will soon be available on the society's web site (below).** Style follows this issue. Reprints may be ordered and will be provided at a charge equal to the Society's cost.

The deadline for submitting material for the Summer 2007 CALS Bulletin is 4 May 2007.

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Front cover: *Ileodictyon* sp. (see article on p. 35). Photography by Darrell Wright.

Bulletin of the California Lichen Society

VOLUME 13 NO. 2 WINTER 2006

Cladonia firma in San Luis Obispo County, California

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ABSTRACT
The populations in California are verified as Cladonia firma sensu stricto.

KEYWORDS
Cladonia firma, Los Osos, Montana de Oro State Park, San Luis Obispo County, lichens of California.

***Cladonia firma* (Nyl.) Nyl.** Bot. Z., 1861: 352, 1861. Type: **Portugal:** Algarve, marim in glareosis maritimis, elevation about 5 m *C.N. Tavares: Lichenes Lusitaniae selecti exsicatti No. 39* (H! neotype)

Basionym: *Cladonia alcicornis* var. *firma* Nyl., Syn. Lich., 1: 191, 1858.

Synonyms: *Cladonia foliacea* var. *firma* (Nyl.) Vain.; *Cladonia nylanderi* Cout.

INTRODUCTION

Botanist Jeanne Larson first discovered an unusual *Cladonia* species with large green cleft squamules in a vacant lot next to her parent's home in 1973 in Los Osos in San Luis Obispo County, California. Charis Bratt collected specimens in Los Osos in the 1980s and brought them to the attention of *Cladonia* specialists Samuel Hammer and Teuvo Ahti. Ahti considered the specimens to be *C. firma,* previously known only as an old-world species, but Hammer considered the Los Osos populations to represent *C. firma* in a broad sense and felt they could belong to a separate, though superficially similar taxon (Hammer, pers. comm.). Despite this divergence of opinion the Los Osos populations were published as *C. firma* (Hammer 1991, 1993) with a later cautionary note that the identification was not taxonomically clear because of their divergent opinions (Ahti and Hammer 2002).

When *Cladonia firma* was first collected it was locally abundant in the Los Osos area. Recently housing developments have spread through the Baywood-Los Osos area, severely reducing local habitat and extirpating populations. Existing populations are separated and several are in decline.

Concern for the conservation of the dwindling populations in the Los Osos area, spear-headed by conservationist David Magney and California State Park ecologists Lisa Andreano and Mike Walgren, stimulated the authors to undertake a taxonomic study of the remaining populations to decide whether they were *Cladonia firma* in the strict sense or a species new to science. In this paper, we report the results of our study. Our observations are based on field studies conducted in 2006 as well as specimens collected specifically to represent a full suite of morphological variation.

TAXONOMIC AND ECOLOGICAL DESCRIPTION OF LOS OSOS SPECIMENS

The thallus is squamulose and the squamules are persistent forming small clumps, 2-25 cm in diameter, often sterile and without podetia when young. It is conspicuous when dry because the large squamules roll inward, are upright and densely packed together, exposing white or brown, esorediate undersides. The primary squamules are the largest in California, up to 25 mm long and 10 mm wide, deeply cleft and digitate with often secondary crenulation. They are up to 250 µm thick. The crenulations of squamules elongate into digitate straps at the end of which new squamules form (Figures 1a and 1b). It is this process of elongation that gives the species its complex form (Figure 2). In undisturbed sites, *Cladonia firma* forms contiguous populations. In mildly disturbed sites, *C. firma* readily fragments, eventually forming new thalli that are tangled, attenuated structures of interconnected squamules, stalked pycnidia, and podetia with secondary squamules. This ability to easily regenerate, even if turned completely upside down, is well-adapted to the sandy maritime sites *C. firma* favors where animals, winds or rainstorms may fragment, flip, or partially bury individuals (Figure 2).

The thallus does not usually grow directly on the sand in the Los Osos and Montana de Oro populations, but actually favors openings in the maritime dune scrub or openings formed by the death of maritime chaparral where the sand is covered with a thick layer of detritus and there is abundant rabbit dung. It also grows on mosses. These sites are generally level or gently inclined.

The lower surfaces of the squamules are corticate with periclinal prosoplectenchyma and covered with a thick white fibrous coat of fine hyphae. In older squamules, this coat can blacken, probably due to interaction with soil or bacteria. Usually the fibrous coating eventually thins or disappears and the cortex turns dark brown. This can appear in fresh specimens to have a bluish tint to some people.

The upper surface of the squamules is a green to olive, sometimes becoming brown. It is glaucescent because of a syncortex *in sensu* Knudsen (Knudsen *in prep*.), an upper and uneven gelatinous coating up to 100 µm thick, punctuated with pits and valleys where

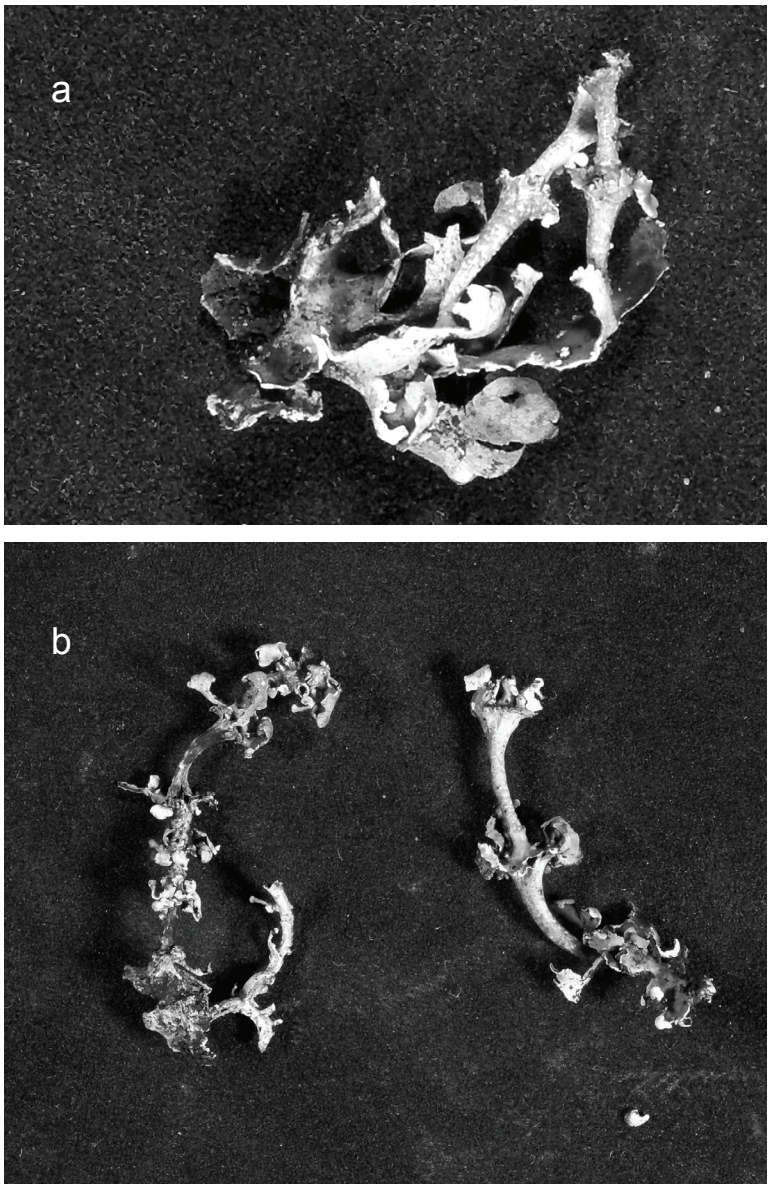

Figure 1. Typical developments of thalli. Photography by James C. Lendemer.

the gelatinous layer is often as thin as 5 µm. This variation of thickness gives the surface a bumpy texture which is probably functional because water accumulates between the thick bumps in lower areas on the squamule surface and can easily be absorbed where the gelatinous layer is thin. The eucortex *in sensu* Knudsen is formed of mostly anticlinal prosoplectenchyma and is 30-50 µm thick beneath the upper syncortex.

The podetia usually begin from the center of the primary squamules (Figure 1b), arising to a height of up to 15 mm, sometimes branching, but narrow, usually 1 mm in diameter. Several podetia can arise from one squamule. The podetial surface is corticated and covered with bumps which are nascent squamules but can develop into new podetia if flipped over. The podetium is cup-bearing, the cup usually abruptly flaring out. The cups are usually shallow, 2-3 mm in diameter, and often one to three podetia arise from the center to form a second or third tier, resembling *C. cervicornis* (Ach.) Flotow. Sometimes secondary squamules develop around the rim of the cup or apothecia or pycnidia. It should be noted that these podetial characters are common in the *C. cervicornis* group and are pleisomorphic and not unique to *C. firma*. But the podetium of *C. firma* thickens and readily elaborates (see Figure 1).

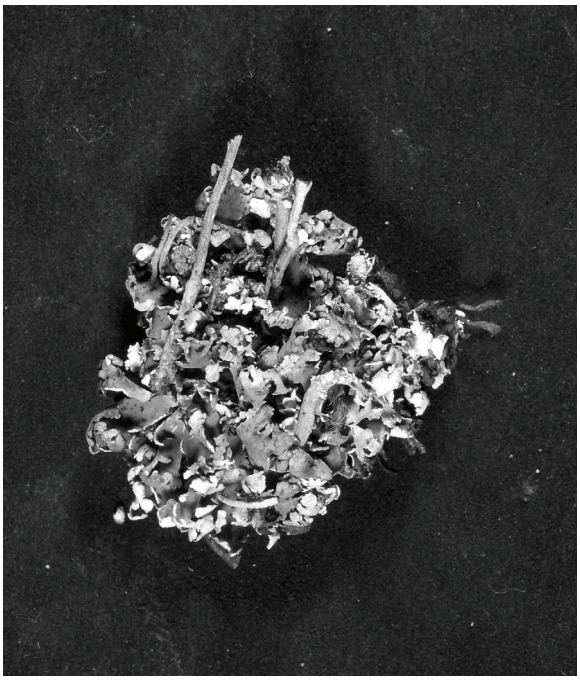

Figure 2. Thallus of *Cladonia firma* (Nyl.) Nyl. Photography by James Lendemer.

Most herbarium specimens from California lack podetia. Actually, this absence is due to collection bias. In Los Osos, specimens with podetia were collected separately and identified and reported as *C. cervicornis*. Actually the two species can be easily separated: the squamules of *C. firma* are distinctly larger, *C. firma* contains atranorin which *C. cervicornis* s. str. lacks, and *C. cervicornis* (which is rare in Los Osos) has larger podetia.

The apothecia are brown and usually develop sessile or stalked on the rim of cups. The ascospores are hyaline, simple, and 14-17 x 2-4 µm.

The pycnidia are brown, urn-shaped, sessile or stalked, arising on the edge of cups, on the sides of podetia, and from upper surface of primary squamules. The conidia are sickle-shaped, 5-7 x 1 µm.

Fine rhizohyphae, acting as anchors, can occur on the underside of thalli.

Comparison with the neotype of *C. firma* as well as with a selection of European specimens showed no morphological divergence in the structure of the thallus, the podetia, or in conidia, or spores. Thus we consider the Los Osos-Montana de Oro populations to be *C. firma* in the strict sense.

Cladonia firma can be easily determined by its large primary and persistent squamules, the largest in California (see Figure 2). The key in *Lichen Flora of the Greater Sonoran Area*, Vol. 2 (Ahti and Hammer 2002) works well for determining all *Cladonia* collected so far in San Luis Obispo County.

CHEMISTRY

European specimens of *C. firma* contain atranorin and fumarprotocetraric acid with smaller amounts of protocetraric acid and confumar-protocetraric acid, which is part of the fumarprotocetraric acid chemosyndrome (annotation of high performance liquid chromatography by K. Huovinen and T. Ahti in 1985 on Follman: Lichens Exsiccati Selecti A Museo Historiae Naturalis Casselensi Editi No. 124, H!)

All specimens from Los Osos were tested with thin layer chromatography (TLC). HPLC tests of specimens of *C. firma* from Los Osos were not performed. All of the specimens reviewed for this study contained atranorin as an accessory to fumarprotocetraric acid. They were consistent in the production of fumarprotocetraric acid throughout the

thallus and inconsistent in the production of atranorin in all parts of their thalli in high enough concentrations to be detected by spot tests or TLC. This led to some samples appearing to lack atranorin when first run through TLC. Adequate thalli samples are needed for good atranorin results. Spot tests were P+ orange, K+ yellow or rarely K- or a dingy yellowish reaction that is not very conclusive.

There are atranorin-rich populations of an undescribed species in western North America, reported by Ahti and Hammer (1990) and included in *C. cervicornis* (Ahti and Hammer 2002). This species occurs from Amador and Lake Counties to Torrey Pines and Point Loma in San Diego County, California, in small scattered populations. But it is abundant on Santa Rosa Island, the center of its distribution. Like *C. cervicornis* and *C. firma* it has tiered corticate podetia. Like *C. firma* it has atranorin. It has smaller, simpler squamules than *C. firma.* Its podetia tend to be one-or-two tiered and smaller than *C. cervicornis*.

DISTRIBUTION

Cladonia firma is abundant locally in Spain and Portugal with populations scattered in sandy maritime habitats around the Mediterranean as well as on the Canary Islands and the Channel Islands of Great Britain.

There are five known sites of *Cladonia firma* in California (see Figure 3). In recent surveys we have observed only two major populations, one in Los Osos and one in Montana de Oro. Both contain thousands of individuals. We observed two other populations. One was on a vacant lot in Los Osos were it occurred on detritus under several decorticate and lichen-covered shrubs. The other was off Baywood Heights where according to David Magney (pers. comm.) about 500 individuals persist scattered across the lower section of a 70-acre parcel. A third major population was surveyed by David Magney south of Los Osos Middle School on Pismo Street. He has estimated a population of several thousand thalli on five acres. We have not observed it yet.

The populations in Los Osos and Montana de Oro are the only known occurrence of the species in North America. We expect more populations to be found in Montana de Oro State Park and on scattered parts of undisturbed land in Los Osos. Though it is possible new populations will eventually be discovered in other parts of western North America, it should be kept in mind that coastal habitats like Los Osos with the unique combination of stabilized dunes with open maritime scrub and particularly moist maritime conditions may not be as common or undisturbed as one might hope.

CONSERVATION

The major threat has been realized and most of the stabilized dune habitat between the Powell property in Los Osos and Montana de Oro State Park has been developed. The remaining populations are the separated remnants of what was probably once a large and contiguous local distribution.

The Powell property in Los Osos is divided between Fish and Game and the state parks. There are several thousand individuals of *C. firma* scattered around the area. It is unfenced, across from a school with several houses in the area. People regularly walk through the area for recreation, sometimes taking their dogs with them, probably not more than a few per day at most. But the sand is very fine and deep. People walking through the area tend to avoid the thickets of oak and chaparral and follow the openings in the maritime scrub where *C. firma* is most likely to occur. Just normal walking begins to churn the sand and suck under detritus, bryophytes and *C. firma,* burying them. Dogs do more damage. Even in areas

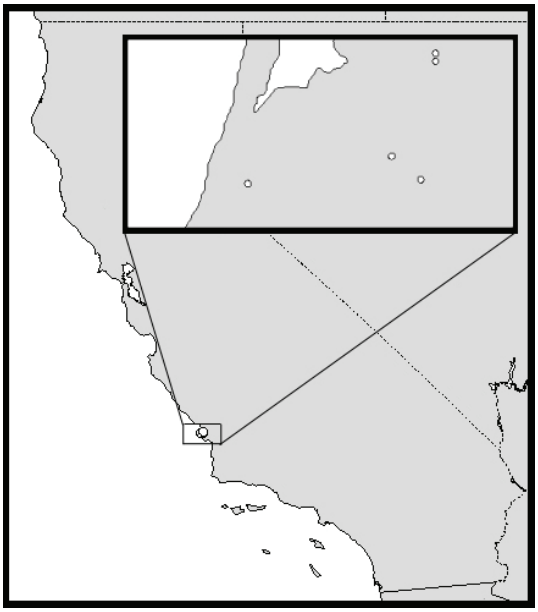

Figure 3. Map of distribution of *Cladonia firma* in North America.

at the Powell property that look undisturbed many thalli are fragmented, lying on the sand.

The conservation of the populations at Powell can only be achieved through the fencing off of the area and any recreational walking, if allowed, restricted to elevated walkways or fenced trails as is done at the nearby Elfin Forest Preserve. We hope one day the management of the Powell properties will be consolidated and the area given preserve status.

The population of several thousand individuals in Montana de Oro, on a sandy ridge above the Sand Spit area, is undisturbed on beds of detritus, forming thick stands of contiguous individuals. These look like the best European specimens we have seen. Though near a well-churned trail that leads to the beach, there were no signs of human or animal disturbance. The Montana de Oro population could be impacted if a new trail was made through its area to allow the old trail to be rehabilitated.

Exploring the Los Osos area, it was evident that much suitable maritime dune scrub habitat is over-run with Veldt grass (*Ehrharta calycina* Sm.). In fact, in central California there is supposed to be more perennial Veldt grass than in its native habitat in South Africa (Walgren, pers. comm.). This is probably the single greatest threat to the remaining populations of *C. firma.* This invasive grass needs to be regularly monitored and removed. The maritime dune scrub at the Baywood Heights site is suffering a massive invasion of Veldt grass and if it continues we expect *C. firma* to eventually disappear from that property.

CONCLUSION

Though we consider based on morphological and chemotaxonomic evidence that the Los Osos populations are *Cladonia firma* in the strict sense, the next step in studying this disjunctive occurrence in North America would ideally be the comparison of molecular markers of both the fungal and algal components of the Los Osos populations with European and Canary Island populations of *C. firma.* Though we would not expect to have to re-evaluate its species concept using different character states that are not apparent at this time, we do expect such research to shed light on the fascinating subject of the lineages of *C. firma.*

As concerned scientists, to help assure proper management on public lands of *Cladonia firma*, we are sponsoring the species through the listing process of the California Lichen Society's Conservation Committee, so that the species may fall under protections provided by the California Environmental Quality Act.

SELECTED SPECIMENS

CORSICA. Ajaccio, vägbrant, 1887, *Norrlin s.n.* (H) [det. by Nylander]. FRANCE. Dept. Finistère: Forêt du Cranou, on silicate soil with iron content, *Lambinon 60/F/731* (H); Dept. Vendeè: Ile d'Yeu, *Marais 1754* (H). GREECE. Dalmatien, *Poelt s.n. = Plantae Graecenses* 14 (H). PORTGUAL. Algarve, marim in glareosis maritimis, *Tavares s.n. = Lichenes Lusitaniae selecti exsiccati 39* (H, neotype). SPAIN. Andalucía: Prov. Huelva. Coastal formation E of Mazagón near Torre del Oro, *Follman s.n. = Lichenes Exsiccati Selecti A Museo Historiae Naturalis Casselensi Editi 124* (H). Canary Islands. Gomera, Vegaipala between Montaña de Yerta and Tagamiche, *Follmann s.n. = Lichenes Exsiccati Selecti A Museo Historiae Naturalis Casselensi Editi 341* (ASU); Soria. Matalebreras (40 km NEE of Soria), common on basic soil, *Ahti & Burgaz 50776a* (H). USA. California: San Luis Obispo Co.: Los Osos, state park property (Powell 1), east of Bayshore Drive, 35° 19' 37"N, 120° 49' 13"W, locally common on Baywood fine sand in opening of chaparral, elev. 27 m, *Knudsen 5013 & Lendemer* (UCR, hb. Lendemer), *Knudsen 4547.1 & Andreano* (UCR); sand dunes, *Bratt s.n. = Cladoniaceae Exsiccatae Americanae 43* (ASU, NY); ridge N of Baywood, SE of Morro Bay, *Bratt 7273* (ASU, SBBG); s/e corner of South Bay & Nipomo Street, 35° 18' 01"N, 120° 49' 27"W, elev. 36 m, *Knudsen 2776* (UCR); Cordoniz property, east of Bayview Heights & Calle Cordoniz, 35° 18' 19"N, 120° 49' 54"W, elev. 78 m, *Knudsen 7352 & Andreano* UCR); Montana de Oro State Park, ridge of stabilized dunes, 35° 17' 58"N, 120° 52' 08"W, elev. 75 m, *Knudsen 7261* (H, PH, UCR); Montana de Oro State Park, *Riefner 87-39* (UCR).

ACKNOWLEDGMENTS

We thank Trevor Goward and Eric Petersen for reviewing this paper. We thank S. Hammer and T. Ahti for their comments and help, the California State Parks for access to their properties, Lisa Andreano and Mike Walgren for aiding us in the field as well as giving us shelter, David Magney for stimulating our interest in the first place and encouraging our investigations and supplying his own unpublished

data, as well as J.A. Elix, Charis Bratt, Shirley Tucker, and the curators of ASU, H, NY, SBBG, SFSU and UBC for loaning specimens.

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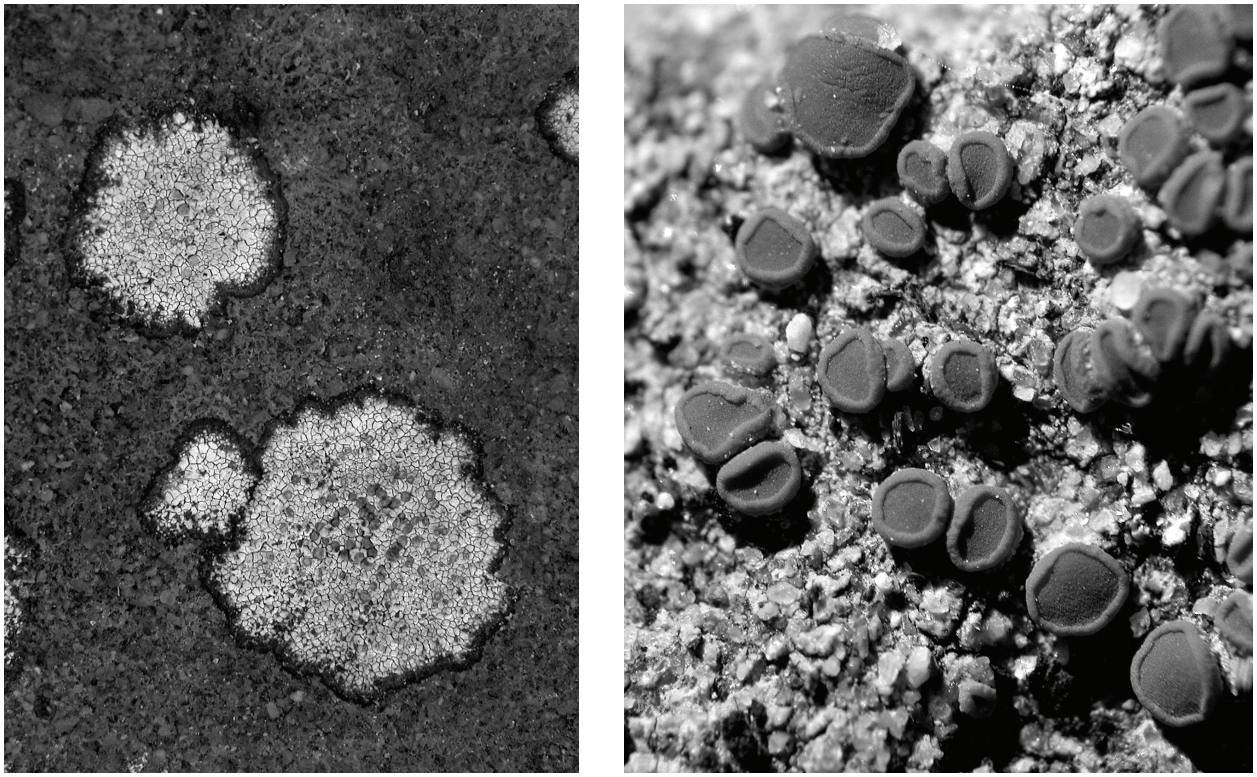

Crustose lichens at Torrey Pines State Reserve: *Buellia maritima* (A. Massal.) Bagl. (left) and *Caloplaca luteominia* (Tuck.) Zahlbr. var *luteominia* (right). Photography by Rolf Muertter.

An Odd Non-Lichen Fungus With an Echo of The Lichens

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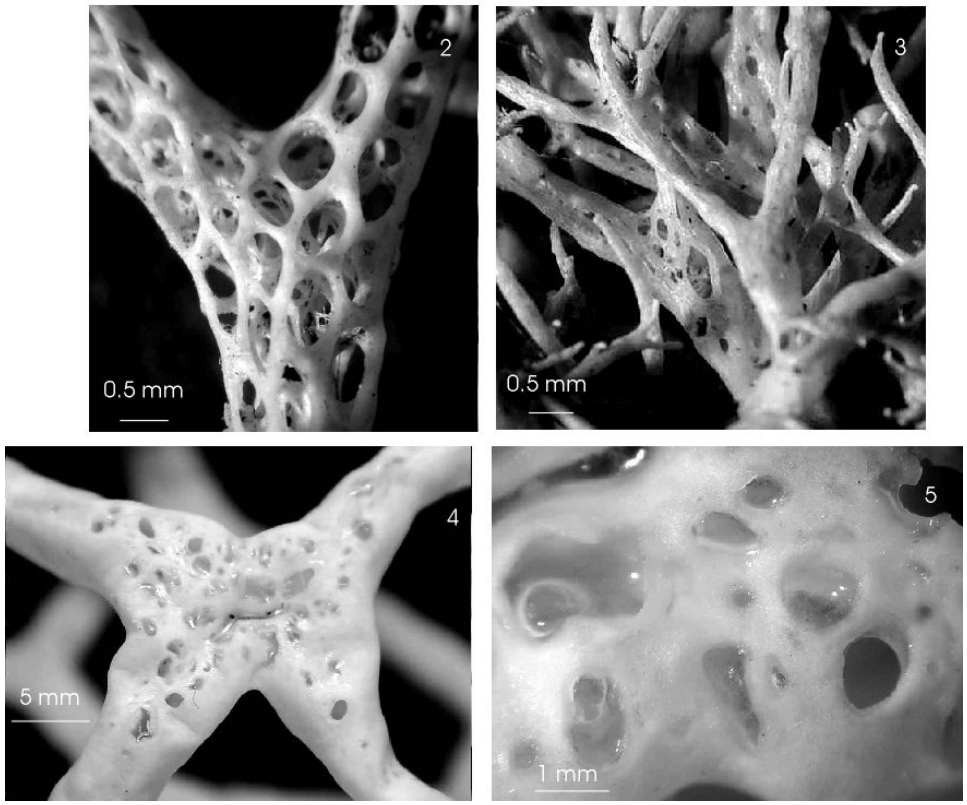
After dinner at East Taratahi, Carterton, lower North Island, Ashley Toms brought in the object in Figure 1 (front cover), which he had found on the floor of a 10 acre remnant of podocarp forest on the property. After working out that it was some sort of fungus, I noted similarities to the lichens *Cladia* and *Ramalina*. The three dimensional net is reminiscent of *Cladia retipora* (Figure 2) of New Zealand and Australia, and the perforations remind one of other *Cladia* species and of *Ramalina* section Fistulariella, e.g., *R. dilacerata* (Figure 3) of North America. The hollow, tubular, more or less cladoniform branches also suggest the lichens.

A search of the internet turned up some very good on-line guides to the non-lichen fungi of New Zealand (there seem to be none of these for the whole of North America, and one author claimed there is not even a checklist of North American non-lichen fungi!). Several of these guides showed the fungus to be *Ileodictyon* (*intestine* and *net*), Basket Fungus, perhaps *I. gracile* because of the expanded nodes rather than the more common *I. cibarium*. *Ileodictyon*, formerly placed in *Clathrus*, has a nearly worldwide distribution but does not seem to be in North America. I wondered if there might be some ancestral connection between it and *Cladia* apart from the fact that they are both fungi.

Ileodictyon is a member of the Phallaceae, the stinkhorn fungi, basidiomycetes which are unusual in that the spores are dispersed not by air currents or water but by insects which are attracted to the carrion odors which the fungi produce. What you see in figures 1, 4, and 5 is called a receptacle or popularly an "egg" (Maori referred to the "eggs" as *tutae kehua*, the feces of ghosts, or *tutae whetu*, the feces of stars!). The "eggs" develop in what looks like a puffball. At maturity the puffball bursts releasing perhaps 10 "eggs", which expand into these geodesic dome type cages (I found comparisons to Buckminster Fuller balls and to soccer balls with the panels knocked out). The spores are produced in a foul smelling gelatinous mass (gleba) on the insides of the hollow tubes, called "arms," of which the cage is formed. I saw no mention of the perforations (Figures 4 and 5).

Several writers theorized that the fungus would be dispersed when the "eggs" were blown about (they are not attached to the substrate). Wind might help to move the "eggs" over short distances on the forest floor in tumbleweed fashion but would not account for the release of the spores which are fixed in the sticky mass inside the cage members, that is, the perforations are not for the spores to merely fall through. I think they must be portals for the insects which enter the tubular arms of the cage to feed on the spores and end up getting them stuck to their bodies. I found an insect larva within one of the arms, suggesting that insect mothers lay their eggs within the arms where the eggs are sheltered and there is food ready and waiting for the emerging larvae.

But has this fungus anything to say about the lichens? Probably not. First, *Ileodictyon* is a basidiomycete while *Cladia* and *Ramalina* are ascomycetes, belonging to that group of fungi, very different from the basidiomycetes, of which most lichens are members. Second, the analogous structures have different ontogenies. In *Ileodictyon*, the baskets develop by linking up (anastomosing) of the arms (Cunningham 1931; some related *Clathrus* species have arms which join only at the apex of the receptacle or not at all), while Hammer (2000) has shown that the perforations in *Cladia retipora* develop from creases in the branches, which correspond roughly to the "arms" of *Ileodictyon*. Third, the analogous structures have different functions. In *Ileodictyon* they are bound up with reproduction and dispersal (Cunningham 1931). As far as is known there is no connection between dispersal and the perforations of *Cladia* and *Ramalina*. The tiny perforations of *Cladia* spp. other than *C. retipora* and of *Ramalina* section Fistulariella may help to hydrate the thallus by admitting atmospheric moisture to the interior in dry weather. Many *Hypogymnia* and *Cladonia* species have perforations which could perform a similar function, and *Menegazzia* is famous for them. This looks like



1. [On front cover] *Ileodictyon cf. gracile* Berk., *D.M. Wright 7808*, East Taratahi, Carterton, New Zealand. Receptacle or "egg".
2. *Cladia retipora* (Labill.) Nyl., *D.M. Wright 7646*, Abel Tasman National Park, New Zealand.
3. *Ramalina dilacerata* (Hoffm.) Hoffm. (*Fistulariella minuscula* [Nyl.] Bowler & Rundel), *D.M. Wright 7099*, Elk River, Humboldt Co., California.
4. *Ileodictyon 7808*, arms with perforations at nodes.
5. As for 4, close-up of perforations, some of which contain rainwater.

an instance of convergent evolution, of unrelated or distantly related organisms which have independently developed similar morphologies, in this case by different routes and for different purposes.

However, if, during its further evolution, *Ileodictyon* were to meet a nice compatible alga...

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Notes on the Lichen Flora of California #3

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ABSTRACT

Terricolous lichen habitat and terricolous species are discussed in California.

KEYWORDS

Acarospora schleicheri, *Acarospora terricola*, Casper Wilderness Park, Cladonia nashii, lichens of California, Santa Rosa Plateau, terricolous lichens.

Working in the field in southern California, I am impressed with how extensively terricolous lichen habitats have been destroyed. Before Thanksgiving I visited the Casper Wilderness, an Orange County park, in the coastal foothills of the Santa Ana Mountains to take a look at the local lichen flora with Senior Ranger Donna Krucki and Ranger Joy Barnes, who is moving to Washington in December.

In the openings of the coastal sage scrub and chaparral, non-native grasses, dried out by the long hot summer, were dominant. Ecologically these ruderal grasses are especially dangerous because they add a fuel load to an area that is susceptible to fires. These grasses, and the weeds associated with them like Eurasian mustards and star thistles in moister areas, have taken over a habitat that once supported a flora of native annuals and native bulbs as well as terricolous lichens and native grasses.

Donna, a ranger at the park for twenty years, led Joy and me to an area where she had seen lichens on soil. The site was sad. The area was clay. On the edges of eroded runnels, *Cladonia nashii* Ahti was reduced to depauperate squamules and scattered stunted podetia hard to recognize from other species. *Cladonia nashii* is apparently endemic to California and is a member of the *Cladonia humilis* group as is the closely related *Cladonia hammeri* Ahti. *Cladonia nashii*, despite the description in the Sonoran flora that it has farinose soredia (based on a handful of specimens) (Ahti and Hammer 2002), eventually develops consoredia on its short expanded dentate cups that form granulose structures which are ecorticate piles of stringy hyphae and algae in clear globes of gelatinized hyphae. When the cups are disturbed the sorediate gobs are knocked loose, but more often in rain when the cups fill with water, the granulose soredia float loose and eventually spill or are splashed on to the soil spreading the species. *Cladonia hammeri* is almost indistinguishable because it has granulose soredia too but these granules tend to be corticate. *Cladonia nashii* contains atranorin which can usually be seen if one allows bubbles of K to form on the podetia which are a rich yellow that does not turn a murky red. Rarely is TLC needed. *Cladonia hammeri* does not contain atranorin.

Anyway, seeing these poor *Cladonia* clinging to the last tiny niches and barely thriving, I lost hope in Donna showing me any interesting soil lichens. Instead I collected lichens off a pile of sandstone rocks deposited by erosion, showing each one to the rangers and telling stories and answering questions.

But Donna, aware I was disappointed, urged us on to see another site. We bushwhacked and I was thinking I needed to get away from my microscope and computer more as I sweated in the unusually hot November afternoon and chaparral branches stabbed me in the legs. Eventually we found the trail Donna was looking for and climbed up a long ridge. On its long lanky peak were barren white patches where eroded sandstone formed thin and nutritionally poor soil over bedrock with scattered nodules of rusty iron-rich sandstone. Donna and Joy told me that most of the rare annuals discovered in the park had been found on these barren patches which I could see on other ridges.

I immediately recognized the rare soil lichen I have been studying, the brown *Acarospora terricola* H. Magn. (see the upcoming book on soil crusts by Bruce McCune and Roger Rosentreter for excellent pictures). It can look a little like the pruinose *Psora pacifica* Timdal that was growing nearby. This was only the seventh site I have found *A. terricola* in California and I know of only three specimens from other locations, one in southern California near Banning collected by Wetmore, and one specimen each from Washington and Nevada. The type

specimen was originally collected by Hasse in the Santa Monica Mountains (W!).

On the white patch on the ridge was the brownish *Lecidea fuscoatra* (L.) Ach. But everywhere was a lichen with black lecideine apothecia too but with a thin whitish thallus barely emerging from the sandstone. These turned out to belong to an apparently undescribed *Sarcogyne sp.* I have never seen before though I regularly collect and study the genus. It may be related to a specimen that Bruce McCune has found in Oregon forming a thallus.

Carefully walking forward, suddenly I saw the yellow *Acarospora schleicheri* (Ach.) A. Massal. and got really excited. Based on herbarium collections and Hasse (1913) it was once common in southern California. After four years of surveying I have still not found it in the Santa Monica Mountains. It was once common according to Hasse in Lake Elsinore too near where Liz and I live but after years of collecting in this area I know of only one site in the Menifee Hills. And I have only found one site in the Santa Ana Mountains so far. *Acarospora schleicheri* is a beautiful granular yellow crust with many dark discs. I no longer glue collections of it because I am interested in its dense anastomosing rhizohyphae which grow underground and slowly spread a population outward. It is especially sensitive to any disturbance as is *A. terricola.* Even one too many visits by lichenologists can lead to its demise.

As I drove back over the Santa Ana Mountains, playing over and over a new ragged hard-driving song by Bob Dylan, I didn't even hear the music as I dreamed of what southern California must have looked like before the Spanish came with cattle and the first weeds. But such thoughts have a hard sad edge that cuts deep and an awareness of an irrevocably changing natural environment can lead to cynical feelings of hopelessness and a tendency to project into nature an ugliness that can blind us to those high white ridges of hope that rise above the grass-coughed slopes.

A week later, as December began, I was out hiking on Santa Rosa Plateau more out of a resolution to get more exercise than to collect though I had a permit and my collecting backpack was heavy with hammers and chisels, shears and saws. The plateau, famous for its vernal ponds, was once the Santa Rosa Ranch. Native grasslands were reduced to ruderal grasslands by decades and decades of grazing. Listening to my friend, the resource manager Carole Bell, talk about the plateau I was deeply impressed at what a long hard struggle it is to restore the native grasslands and to prevent weeds from building up fuel loads that could destroy the oaks and chaparral in a catastrophic fire.

Looping back toward my car across the Mesa de Colorado, I went off trail to examine the lichens on the basalt outcrops that stick out of a heavy clay soil which lies thinly over a basalt bedrock that supports vernal ponds. Poking through the grass, I was surprised to see in a reddish opening a small thriving population of yellow *Acarospora schleicheri* growing with a sterile imbricate *Placidium* sp. and *Trapeliopsis glaucopholis* (Nyl. *ex* Hasse) Printzen & McCune. This whole mesa had been heavily grazed for almost a century and if the propagules of these lichens hadn't blown in, then remnants had managed to survive around the edges of the low protruding basalt outcrops.

The soil lichens were coming back.

Next day I saw Carole Bell and while we were driving in her distinctive purple truck over to see a prescribed burn site I asked her when they had stopped grazing cattle on Mesa de Colorado. She said 1986. I told her about the recovering terricolous lichen community. She became concerned and said they had burned there maybe in the early nineties to knock back the non-native grasses. Would a prescribed burn hurt the lichens? Of course it would. But next time, if it becomes necessary to do a prescribed burn, she'll make sure there are cleared areas around the soil communities. They will survive and thrive.

There's hope.

ACKNOWLEDGMENTS

Special thanks to Amanda Heinrich for reviewing this paper. Special thanks to Joy Barnes, Donna Krucki and Carole Bell, women out there making a difference.

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Mutualism in Lichen Symbiosis

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Ever since Simon Schwendener determined that lichens were a combination of a fungus and an alga in 1869, lichenologists have had differing opinions about the type of symbiosis lichens represented. For many years the prevailing thought was that the fungus was parasitizing the alga although not to the point of killing it; in other words, controlled parasitism. But that determination was not unanimous. There were always some who felt that for a lichen symbiosis to have been so successful and continuous over time it must have been mutually beneficial – a sample of mutualism. So even though Ernie Brodo, in his big volume "Lichens of North America," stuck with controlled parasitism, Tom Nash saw the lichen symbiosis as "a classical case of mutualism," as did Rosemary Honneger in 1991, and Dr. Larry St. Clair of Brigham Young University in his lecture at San Francisco State on May 10, 2006, entitled "The Case for Mutualism" and prepared in collaboration with Kathleen Knight, also from Brigham Young.

After an introduction which answered the questions "what are lichens, where are they found (everywhere) and what do they grow on (everything)," Dr. St. Claire embarked on his main point by showing a very good illustration (photo by Ahmadjian) of an alga being clasped and held by fungal hyphae, at which point he explained that if the alga was not the right one in the eyes of the fungus, the fungus would kill it and look for another one. In other words, the two partners have to be compatible for a lichen thallus to evolve from the combination.

As to when lichens first appeared on earth, the fossil record is poor. But based on the fact that both algae and fungi had to be present for this symbiosis to exist, lichens probably appeared in the Silurian period, about 440 million years ago. The most primitive lichens are leprose ones. These lichens have no real thallus but consist of granules made up of a few fungal hyphae and a few algae. Fruticose lichens with their more complex thalli followed, as did the foliose and crustose genera, each introduced in this lecture by illustrations of their distinctive structures. For instance, the lower surface of crustose lichens does not have a lower cortex and the fungal hyphae can penetrate the rock substrate to a depth of 10 millimeters.

Algae reproduce only by cell division within the lichen thallus; and the fungus also reproduces largely by vegetative means. Vegetative reproduction in lichens is aided by soredia, small granules of a few fungal hyphae and a few algae which are easily spread by wind or animals or rain, and by isidia, small finger like projections from the thallus which are designed to break off and spread the lichen to new areas, carrying a bit of cortex along as well as the fungus and the alga.

The fungus does reproduce sexually in many lichens, and Dr. St. Claire showed diagrams of the apothecia where the spores develop. When the spores are mature and become scattered they must find an alga to capture before they can develop into a lichen. Interestingly enough, the algal genus *Trebouxia* is rarely if ever found living independently in nature, even though it is the alga most commonly found as a photobiont in lichens.

Getting down to the nitty gritty of symbiosis, which partner benefits the most in this arrangement and which one provides the most? Who provides what? Is it mutual?

What does the alga contribute?

1. The alga, as photobiont and thus the one who does the photosynthesizing, produces fixed carbon, and transfers 90% of its carbon production to the fungus, providing its partner with energy and the building material it needs for growth and repair. Fungi are made of chitin, the production of which requires a lot of carbon. The algae produce more fixed carbon overall when in this symbiotic relationship than when alone.

2. In addition, about 5% of lichens have cyanobacteria for their photobiont instead of algae, and they are able to fix nitrogen as well as carbon and pass that on to the fungus to help meet basic metabolic needs. There are also some lichens which have basically green algae for their primary photobiont, but also have structures called cephalodia, small outgrowths from the thallus, in which cyanobacteria are located.

In short, the alga contributes carbon, and in some cases, nitrogen.

What does the fungus contribute?

1. Nutrient transport. When the lichen thallus is saturated with water, as it is on a regular basis under ideal conditions, it would be very difficult for CO_2 to be available for the algae to fix it and thus make it available to the fungus. To circumvent this problem, the fungus forms conduits along the inside walls of the fungal hyphae in the medulla, and strengthens the walls of this canal by depositing a layer of hydrophobic proteins along the outer wall. Water and nutrients can thus be moved up to the algal layer from the soil layer while keeping the medulla dry enough for CO_2 to be available to the algae.

2. Water storage. The fungal hyphae will suck calcium out of the rock substrate and turn it into calcium oxalate crystals. Some of the water in the thallus is bound to the calcium oxalate, and thus stored for future use. For instance, the fungus can store some of the water deposited by the morning dew, and then release it later in the day so that the alga can continue to photosynthesize when the lichen is dry. The fungal partner has evolved so as to keep the photobiont with enough dampness to continue working. Green algae can photosynthesize with water vapor. Cyanobacteria need liquid water in order to photosynthesize.

3. Gas exchange. Gas exchange of any kind is difficult when there is too much water in the thallus. In addition to helping with CO_2 availability as seen in paragraph one, the fungus also has structures on lichen surfaces which allow gas exchange, in the form of small openings in either the upper or lower cortex of many lichens. These openings are called cyphellae and pseudocyphellae and vary in shape.

4. Light regulation. Calcium oxalate is also deposited as a dust on the surface of the lichen, acting as a kind of sun screen to protect the algae from too much light. Calcium oxalate crystals also affect light by reflecting it back and transforming ultraviolet light into enough white light to allow the algae to photosynthesize more hours of the day. Pigments in the fungus also filter and regulate the amount of light coming into the thallus.

5. Distribution of elements. Phosphorous, chlorine, sulfur and other nutrients are delivered to the algal layer via the canals discussed earlier.

6. Herbivory. Invertebrates like to graze on the lichen algae. The fungus and the alga together produce secondary chemicals which help fight these invaders.

7. Pollution protection. The lichen fungi can neutralize polluting elements that they absorb and store them. Sulfur, arsenic and lead are sequestered in crystal structures to keep them from affecting the algae.

8. Reproduction aids. Fungal and algal components cooperate in forming asexual diaspores like isidia and soredia, which are designed to keep the alga together with the fungus in vegetative reproduction. In some perithecial lichens there are algal cells near the perithecia and spores are sometimes scattered with algal cells on their surface. In one such genus algae are found in the hymenial layer and fungal spores can be discharged with algae attached. In other words, algae can get to places in this symbiotic arrangement that they would never get to otherwise.

The fungus seems to know that it has a good thing going, and it treats its algae well. In return, the alga gives up 90% of its product to the fungus. As Dr. St. Clair put it, “The rent is high, but the returns are incredible for the alga.”

Even though the alga provides all the food, if the fungus is aiding it in eight different ways to lead a comfortable life, the alga resembles a prisoner less than it does a musician in the 18th century who was provided luxurious living conditions in return for

providing the nobleman who employed with his daily dose of original live music. This certainly does sound like mutualism, unless the alga harbors dreams of freedom, which seems unlikely.

A short question period followed the lecture. Subjects discussed included procedure used in separating the alga from the fungus in lichens; nomenclature; other symbiotic relationships; the lack of any exchange of genetic material between the alga and the fungus; the importance of the environment in lichen success; and the fact that cooperation has been found to be more common than competition in the wider natural world.

Thank you, Dr. St. Clair, for taking the time to present such an interesting and informative lecture.

A Note from the Conservation Committee

Over the last few years, the CALS Conservation Committee has been working to develop and implement a strategy for ranking and listing sensitive lichen taxa. In doing so, we have been working closely with the California Department of Fish and Game's Natural Heritage Program, also known as the California Natural Diversity Database (CNDDB), and with the California Native Plant Society (CNPS). As you can see in the pages of this Bulletin, our efforts are beginning to fruit.

California has relatively strong laws for regulating land use in light of rare species. This can bring great scrutiny to listing efforts. At the core of our process is the sponsorship of taxa. This sponsorship is a gathering of background information and known locations within California. Any individual may sponsor a lichen. Recognizing the lack of lichen societies in some states and the greater geographic interests of our own lichen society, we do not restrict sponsorships to the state of California.

When the committee receives a sponsorship, it is reviewed, then presumably accepted by the committee. The sponsorship is then publicized by the CALS email group and letters to stake-holders. Publication in the Bulletin as you see here is not required, but may become commonplace. After publicizing the sponsorship, we generally ask for comments on technical aspects within 90 days, and general review with opportunity for added surveys over a period of one year. After this public review, the committee may act to establish a CALS ranking and listing for the lichen. Our ranking system is built upon Natural Heritage methodology, in use across much of the Americas (http://www.natureserve.org), and functions as a recommendation to the CNDDB. Our listing system is synonymous with CNPS listings.

For more information on our process, go to http://calscc.crustose.net. Additional information on CNDDB and their ranks is available at http://www.dfg.ca.gov/bdb/html/cnddb.html, and on CNPS and their lists at http://www.cnps.org under the Rare Plant Inventory. If you wish to contribute a sponsorship, then please coordinate with the committee so as to not duplicate an effort already underway. Contact the committee chairperson, Eric Peterson, eric@theothersideofthenet.com.

To date, we have accepted 6 completed sponsorships, and at least as many are in progress. Two of those sponsorships have completed the one year review and we are happy to announce the first species officially ranked and listed by CALS. *Usnea longissima* has received the global rank G5.2, the state rank S4.2, and has been placed on list 4 (watch). *Solorina spongiosa* was sponsored for multiple states, receiving the global rank G4G5.3; state ranks S1.2 (AZ), S1.2 (CA), S1.1 (NV), and S2?.2 (UT); and placed on list 2 (rare in state, but more common elsewhere) for all four states.

P.S. Precision location data is removed from specimen lists of sensitive species in order to protect them from poachers and vandals. Yes, that has happened due to publication of data on rare species! The Conservation Committee maintains these data and can make them available for serious scientific needs.

Hypogymnia schizidiata, Sponsorship for the CALS Conservation Committee

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EXECUTIVE SUMMARY

Hypogymnia schizidiata (Island Tube Lichen) is a recently described species that is rare throughout its limited range, from Cedros and Guadalupe Islands in Mexico to Santa Rosa Island and Santa Cruz Island in California. Only four collections are known from the U.S. The species should be sought further on the Channel Islands and populations documented for size, habitat, and potential threats. At this time, no imminent threats are known, apart from an unpopular piece of proposed legislation to convert Santa Rosa Island to a military recreation area.

TAXONOMY

Accepted scientific name: *Hypogymnia schizidiata* McCune.

Common name: Island Tube Lichen.

Type specimen and location: MEXICO: Baja California, Cedros Island, south end, top of hill north of town of Cedros, 28° 8'N, 115° 13'W, 1100 m, on *Juniperus californicus*, with *Pachycormus, Ambrosia*, and *Mammillaria*, Marsh 7384, 21 March 1994 (ASU).

Synonyms: None.

DESCRIPTION

Thallus: appressed to suberect, up to 4 (-8) cm in diam.; texture: cartilaginous; branching: isotomic dichotomous; budding: absent or rare; lobes: separate to centrally subcontiguous, 1-3 (-4) mm broad; black border: not visible from above; profile: even to ± nodulose; width/height ratio: 1-4; tips and axils: perforate, upper surface: greenish gray, greenish, or dark brownish green, often dark mottled, smooth or becoming strongly rugose; schizidia: formed as flakes of cortex plus algal layer, developing from either the smooth or rugose areas of the thallus; soredia: sometimes developing on the edges of the schizidia, particularly in rugose areas of the upper surface, rarely spreading into diffuse laminal soredia; isidia: absent; lobules: rare; medulla: hollow, ceiling of cavity brownish to white, floor of cavity brownish to white; lower surface: black, sparsely perforate; Apothecia: occasional, substipitate to stipitate, up to 6 mm diam; stipe: urn- to funnel-shaped, hollow; disc: light to dark brown; ascospores: ellipsoid, (5.5-) 6.5-7 (-8) x (3.5-) 4-5 μm; Pycnidia: common; conidia: rod-shaped to weakly bifusiform, 6-7.5 x 0.5-0.7 μm; Spot tests: cortex K+ yellow, C-, KC-, P+ pale yellow, UV-; medulla K-, C-, KC+ orange-red, P-; Secondary metabolites: upper cortex with atranorin and chloroatranorin; medulla with physodic acid (major), 2'-*O*-methylphysodic acid (minor), 3-hydroxyphysodic acid (accessory, frequency 25%), unknown C7 (minor UV+ accessory), unknown C8 (minor accessory). Figure 1 (Figure A on back cover).

Similar species and distinguishing characteristics: Production of asexual propagules is rather variable, but in most specimens the cortex tends flake off from both smooth parts and rugose parts, taking with it the algal layer. The type is not as heavily schizidiate as some specimens, but it is fertile and shows the variation from smooth to rugose lobes. True soredia can be nonexistent to well developed. The species is also unusual in its light brownish lobe cavities. In most specimens it is somewhat variable, having pure white portions, occasional dark brown portions, but the majority of the lobe interiors have a loose mesh of brown hyphae over a white background. This plus the frequently perforate lobe tips separate the species from *H. imshaugii.* The P- medulla is also useful in separating *H. schizidiata* from the P+ chemotype of *H. imshaugii*. The somewhat darkened lobe cavities and perforations suggest *H. inactiva*, another P- species, but that species lacks asexual propagules and

Figure 1 (repeated in color on back cover). *Hypogymnia schizidiata* McCune. Bratt 3160a from Santa Cruz Island, showing lobes, perforation in lower surface of lobe tip, and schizidia forming on upper surface of lobe. Ruler has mm marks. Scale bar in lower right is 1 mm. Photography by B. McCune.

differs in accessory secondary metabolites. Small pre-sorediate specimens can be recognized by their brownish cavities, isotomic dichotomous branching, and perforations in the lobe tips and lower surface.

Biological Characteristics

Growth form: foliose lichen.
Reproductive method: typically by schizidia and soredia; more rarely by ascospores.
Dispersal agents: unknown, but presumably wind, birds, and arthropods.
Substrate and specificity: on bark and wood of both hardwoods and conifers, including *Juniperus*, *Pachycormus*, *Pinus*, *Quercus*, and *Simmondsia*.
Habitat and specificity: in woodlands, isolated groves, and forests.
Pollution sensitivity: unknown.
Ecological function: unknown.

Geography

Global: Offshore islands of Baja California (Cedros, Guadalupe) and California (Santa Rosa and Santa Cruz).

Local: In California known only from two collections on Santa Rosa Island, and two collections on Santa Cruz Island.

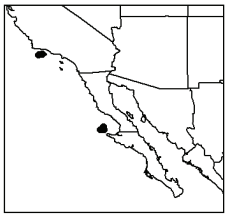
Population Trends

Unknown.

Threats

History: Unknown.

Future: Although widely opposed, legislation has recently (2006) been proposed in Congress to use Santa Rosa Island for military recreation. It is unclear what this would mean in terms of protection for the island ecosystems, but presumably it would be less protected under management for recreation than for management under the National Park Service mandate.



Cedros Island apparently has the largest population of this species. Cedros Island is well known for a high level of endemism. Cedros is remote, isolated, and hard to reach. It is 24 miles long and has about 2700 inhabitants. Apparently many of the inhabitants are unemployed because of changes in the fishing industry. The main industries are fishing and a large salt works. Ownership of the sites where the species occurs is unknown. Cedros Islands is part of a proposal to create a Biosphere Reserve. This will include all the 13 islands of the Pacific coast of Baja

California. Presumably this Biosphere Reserve would provide some measure of long-term protection for *Hypogymnia schizidiata*, but at this point it cannot be considered secure.

PROTECTION

In 1986 the Federal government purchased Santa Rosa Island and designated it part of Channel Islands National Park. In time the island was to become part of our national parks system, but this has not yet been accomplished. See threats above.

CONSERVATION STATUS SUMMARY

Efforts should be made to document size and status of populations on Santa Rosa Island and to search for it on similar Channel Islands. At present, no one has made a focused search for the species, the existing records merely being incidental collections before the species was described.

SPECIFIC CONSERVATION RECOMMENDATIONS

Recommended Global Rarity Rank: G2

Recommended Global Threat Rank: .3

Recommended Local Rarity Rank: S1

Recommended Local Threat Rank: .3

Recommended List: 1B

Recommended conservation/management actions: Document size and status of populations on Santa Rosa Island and search for it on similar Channel Islands.

RELEVANT EXPERTS AND KNOWLEDGABLE LOCAL BOTANISTS

Bruce McCune, Dept. of Botany & Plant Pathology, Cordley 2082, Oregon State University, Corvallis OR 97331-2902 USA.

Kerry Knudsen, Herbarium, Dept. of Botany & Plant Sciences, University of California, Riverside, CA 92591-0124 USA.

STAKEHOLDERS FOR NOTIFICATION OF COMMENT PERIOD

Channel Islands National Park
1901 Spinnaker Dr.
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Santa Barbara Botanical Garden
ATTN: Charis Bratt
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California Dept Fish and Game
Attn: Roxanne Bittman, CNDDB lead botanist
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California Native Plant Society
Attn: Kristi Lazar, Rare Plant Botanist
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LOCATION/SPECIMEN LIST

Specimens other than the type specimen: MEXICO: Baja California, Cedros Island, Marsh 7383, 7388 (ASU), 28° 8'N, 115° 13'W, 1000 m, on *Pachycormus*, Nash 34483; on *Simmondsia*, 34497 (ASU); Cerro Redondo, N-facing slope, 800 m, Marsh 7409 (ASU); N end of island, 28° 22'N, 115° 15'W, 400 m, on *Pinus muricata*, Nash 34257 (ASU); 442-488 m, *Pinus muricata* forest, Beauchamp 62444 (COLO); 28° 8'N, 115° 14'W, on *Juniperus*, Nash 34501 (ASU); 28° 8'N, 115° 13'W, 1050 m, on *Juniperus*, Moran 10647a (ASU, COLO); Guadalupe Island, 1200 m, *Cupressus* forest, Tretiach 31618b,c (TSB). USA: California, Santa Barbara County, Santa Rosa Island, 33° 56'N, 120° 7'W, 480 m, Ryan 31429 (ASU); pine-oak-chaparral mixture, 33° 59'N, 120° 4'W, 260 m, on *Pinus remorata*, Nash 33051a (ASU); Santa Cruz Island, Bratt 1469. 3160a (SBBG).

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McCune, B. 2002, *Hypogymnia*. Pages 228-238 in Nash, T. H., III, B. D. Ryan, C. Gries, & F. Bungartz. Lichen Flora of the Greater Sonoran Desert Region. Vol. 1. Lichens Unlimited, Tempe, Arizona.

Editorial Note: *Portions of this paper are repeated from McCune (2002) with permission from the book's lead author and publisher, Tom Nash, III.*

Sulcaria badia,
Sponsorship for the CALS Conservation Committee

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EXECUTIVE SUMMARY

Sulcaria badia is endemic to the Pacific Northwest with an historical distribution from the Olympic Peninsula in Washington in the north to the general area of Laytonville, California in the south, a range of approximately 585 miles. The contemporary distribution is from Corvallis, Oregon to Lake Pillsbury, CA, a distance of approximately 360 miles. In California it is found in well-lighted *Quercus garryana* grassland communities, and in mature Douglas-fir forests containing a black oak component. Post-2002 discoveries have greatly increased the number of localities and occurrences in California, raising the possibility that this lichen is under-collected or overlooked. It is probably dispersal limited, since neither sexual nor asexual reproductive structures are known in the species. Population trends are unknown, since no monitoring is taking place, although two historical occurrences are presumed to be extirpated. It is a Sensitive plant on four National Forests in northern California.

TAXONOMY

Accepted scientific name: *Sulcaria badia* Brodo & D. Hawksw.

Common name: bay horsehair lichen, grooved beard lichen

Type specimen: holotype F. Sipe #669, OSC.

Type location: U.S.A., Oregon, Philomath. This population was extant in 2004 (McCune 2004)

Synonyms: none.

Note: Brodo & Hawksworth (1977) state that the placement of this species into the genus *Sulcaria* should be regarded as tentative until fertile material can be located. The writing of most contemporary authors treats the species as though that placement were permanent.

DESCRIPTION

"Thallus pendent, 20–50 cm long, flaccid; branching mainly isotomic-dichotomous, angles between the dichotomies mainly acute and rounded; branches markedly flattened and twisted, conspicuously sulcate, 0.25 - 0.4 (1.0) mm diameter at the base, with short, slender almost perpendicular lateral branches; dull chestnut-brown to almost badious or yellowish-brown in parts. True lateral spinules, isidia and soralia absent. Pseudocyphellae conspicuous, white, linear, extremely long, most developing into deep furrows (Figure 1; Figure B on back cover). Apothecia and pycnidia unknown. Acetone extract K+ yellow, C-, KC+ yellow, P+ yellow or brownish" (from Brodo & Hawksworth 1977). From a distance of ten feet, the color is the most distinctive character, although it can be as brown as many *Bryoria*, and when pale can still be confused with *Bryoria capillaris*.

Similar species and distinguishing characteristics: At a magnification of 10-14x, well-developed specimens of *Sulcaria badia* are easily distinguished from other Alectorioid lichens by the deep grooves (pseudocyphellae) that spiral around the main branches. The color of pale forms from shaded locales can be very close to *Bryoria capillaris*, while thalli from exposed locations can be as dark brown as

many other species of *Bryoria*. Several species of *Bryoria* also have pseudocyphellae, but not as deep or long as found in *S.. badia*. *Bryoria* with pseudocyphellae differ chemically, as well: *B. pseudocapillaris* is C+ pink, and *B. spiralifera* is K+ red. *Alectoria sarmentosa* can resemble *S. badia*, but has a stiffer, more robust cortex, thicker branches (to 2.5mm), and its pseudocyphellae are typically raised, as opposed to sunken in *S. badia*. *Sulcaria isidiifera* is outwardly similar, but has a different color, and the pseudocyphellae eventually split open and develop isidia. It is also distinguished geographically: *S. isidiifera* is restricted to San Luis Obispo County, while *S. badia* is not known further south than Lake Pillsbury.

BIOLOGICAL CHARACTERISTICS

Growth form: Fruticose, pendulous, filamentous.
Reproductive method: Primarily asexual; via thallus fragmentation. Apothecia unknown.
Dispersal agents: Birds(?), wind, gravity. Limited dispersal ability.

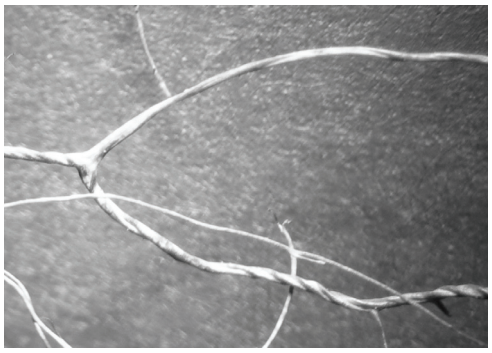

Figure 1 (repeated in color on back cover). *Sulcaria badia* Brodo & D. Hawksw. Main branches (left), showing flattened axil and spiraling pseudocyphellae, and twisted branches (right). Photography by T. Carlberg.

Substrate and specificity: On trees, especially apple and oak trees (Brodo & Hawksworth 1977). It is also found on oaks at sites at Lake Pillsbury and on the Medford BLM District. In northern California on the Klamath and Trinity Rivers, it has been found as litterfall in Douglas-fir/black oak forests. Other substrates include ponderosa pine, *Pinus ponderosa,* Douglas-fir, *Pseudotsuga menziesii*, Oregon ash, *Fraxinus oregana*, bigleaf maple, *Acer macrophyllum*, and *Rhododendron macrophyllum*.
Habitat and specificity: Appears to be a generalist, but is most abundant in the habitat described by Brodo & Hawksworth (1977): "on trees, especially apple and oak trees, in well-lighted *Quercus garryana* communities". The habitats at Laytonville, Lake Pillsbury (Figure 3) and Medford BLM localities are consistent with this description, although the substrates sometimes differ and there is no summer fog at either of the BLM locations (Wineteer 2004). The localities proximal to the Klamath and Trinity Rivers are mid- to late-mature Douglas-fir forests, sometimes with dense sheltering canopy covers and either a sparse presence of black oak (*Quercus kelloggii*), or none. One Oregon site is a coastal dune forest.
Pollution sensitivity: Unknown.
Rcological function: Unknown.

GEOGRAPHY

Global: *Sulcaria badia* is endemic to the Pacific Northwest, known only from thirteen historic and contemporary localities in the United States; in Washington, Oregon and northern California (Figure 2). None of the known localities is further than 85 miles from the ocean. The historic range covers approximately 605 miles, however the occurrence in Washington, at the north end of the Olympic Peninsula, was not relocated by Peterson et al. in 1998, and *S. badia* has not been found elsewhere in the vicinity (Hutten 2004) and is possibly extirpated. The range of extant localities is approximately 360 miles, from Corvallis, Oregon to Lake Pillsbury, California. One historic occurrence in California is possibly extirpated (see below), resulting in ten extant localities for the state. Some localities have multiple occurrences (see below). The Snider and Berry Creek localities are the furthest inland. Both are hot, dry *Quercus garryana* oak woodlands along perennial creeks, and both host substantial

populations of *S. badia* (>¼ mile of creek-side or >1acre of area) (Wineteer 2004). There are two specimens in the Arizona State Lichen Herbarium (ASU) from the Cascade Mountains in Oregon and California. This would appear to be a significant disjunct, but see below.

Local (California): There are seven historic and contemporary general localities in California where *S. badia* is known to occur (Figure 2). Some localities are composed of more than one site where *Sulcaria badia* was found, e.g. the Lake Pillsbury area has nine sites (Toren & Nilles 2003), Hawkins Creek and Campbell Ridge each have two closely-spaced occurrences, and there are four occurrences in the Laytonville vicinity (Peterson et al. 1998). Four of the seven localities have been discovered since 2001. One historic occurrence (Round Valley) appears to be extirpated, the other (Laytonville) was flourishing in 1998, leading Peterson et al. (1998) to state "... these trees probably represent the optimum of currently available habitat for the species". Prior to 2001, the abundant Laytonville locality was the only California locality known to be extant.

The nine Lake Pillsbury occurrences have a number of occupied trees, and abundance of *Sulcaria badia* is moderate to high for a given tree (Toren 2004). In contrast, the Hawkins Creek and Campbell Ridge localities have fewer than 10 thalli reported each, and the Orleans occurrence is represented by a single thallus. These, however, were detections made from litterfall, and it should be borne in mind that because of the nature of the forest (mid- to late-mature Douglas-fir mixed with black oak, in high canopy cover [>60%] stands), there may be a significant additional presence in the canopy, that was not visible from the ground. Even so, it is a habitat that is wildly different from the *Quercus garryana* community that was previously assumed to be optimal, but it will be time-consuming and/or expensive to discover how abundant *Sulcaria badia* is in this habitat.

The two collections in ASU of *Sulcaria badia* are from Fremont National Forest in Oregon and Lassen National Forest in California. These collections were reviewed by Peterson in 1996 and determined to be *Bryoria pseudofuscescens* (Schroeder 2006).

For all localities, there is a distinct possibility that numerous thalli exist in the crowns of trees above and adjacent to the understory locations where

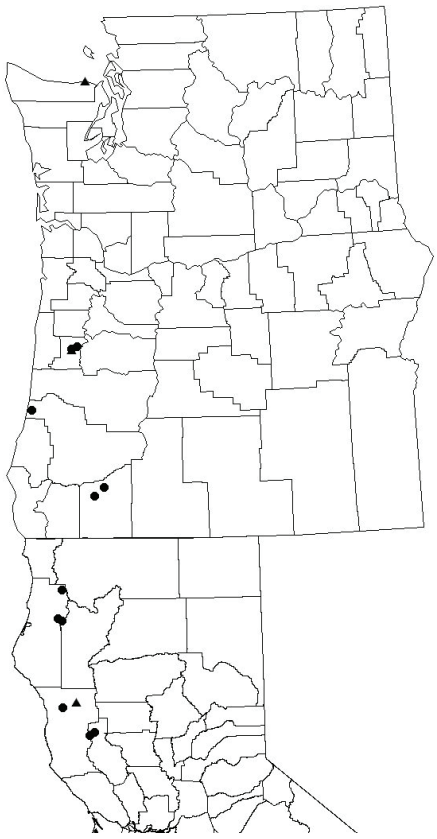

Figure 2. *Sulcaria badia* in the Pacific Northwest. Triangles represent historical sites that are presumed extirpated; circles represent extant sites or localities.

Sulcaria badia is found, since the surveys during which the detections were made were all ground-based. It is also possible that this lichen is overlooked and undercollected, since it shares certain morphological and habitat characteristics with other lichens, and can co-occur with or be dismissed as *Alectoria sarmentosa, Bryoria* spp. and *Usnea* spp.. The modest distance (135 miles) between the northern- and southernmost occurrences in California adds credence to this possibility. But given the distinctiveness of the deep spiraling pseudocyphellae and the small number of ground detections made, it seems reasonable to assume that occupied trees are few, and the lichen is at least uncommon. Wineteer (2004) states that survey intensity around the Snider & Berry Creek BLM areas has been high, and only two localities have been found.

POPULATION TRENDS

Peterson et al. (1998) reported thirteen total, but ten extant occurrences of *Sulcaria badia* in the Pacific Northwest, with five extant and one possibly extirpated in California. The most current information for California, assuming no new extirpations, is that there are six general localities (Figure 2), and nineteen discrete occurrences, using the ¼ mile rule (CNPS 2006; this counts nine occurrences at Lake Pillsbury and five at Laytonville). This increase should not be interpreted as a population trend, since it represents new detections and probably not new recruitment. The lack of any systematic monitoring efforts makes an assessment of population trends impossible at this point.

Figure 3. *Sulcaria badia* on Garry oak at Lake Pillsbury. Photo by David Isle, USFS.

Of the eleven extant localities in Table 1, seven are composed of more than one occupied tree, and 4 consist of fairly large populations (est. < 100 occupied trees) of *Sulcaria badia*. This patchy-clumpy distribution pattern at the landscape level is highly typical of lichens with dispersal limitations, i.e. those that reproduce via large propagules. *S. badia*, as far as is known, disperses solely via thallus fragments.

THREATS

History: Peterson et al. (1998) hypothesize that the Round Valley occurrence may have become extirpated because of marginal drier habitat coupled with a decline in air quality caused by increased human presence (more fireplaces and wood smoke in the winter, when the lichen is metabolically active). The Dungeness area has undergone a conversion to agriculture, which has reduced the amount of forested land, and air quality has declined there, too, as evidenced by the numbers of nitrophilous lichens present. In general, conversion to agriculture or residential threaten this lichen, by removal of substrate trees or the decline in air quality.

Future: Removal of occupied or potentially occupied trees will reduce populations of *Sulcaria badia*, and can occur through real estate development, road building or maintenance, campground building, etc. Conversion from oak woodland to residential usage has a twofold impact: removal of trees and the air quality issues resulting from the increased presence of automobiles. Conversion to agricultural usage has the same threats, with additional impacts from the use of fertilizers and herbicides.

PROTECTION

Status: Sensitive plant in Region 5 of the US Forest Service (California), 2006. Oregon Heritage Program Rank G2 S2. Oregon Natural Heritage Program List 1 (1 = contains taxa that are threatened with extinction or presumed to be extinct throughout their entire range), May 2004 (elevated from List 2 in 2001). Washington Natural Heritage Program List 1(Critically imperiled because of extreme rarity [5 or fewer occurrences, or very few remaining individuals], or because of some factor of its biology making it especially vulnerable to extinction) in 2001, but the current Washington non-vascular publication is not available.

The status of Forest Sensitive plant in the Forest Service in Region 5 affords *Sulcaria badia* protections on Forest Service lands in California; the individual Forests must manage known populations to avoid a trend towards Federal listing with the Fish & Wildlife Service. This affects localities at Lake Pillsbury, Orleans, Campbell ridge and Hawkins Creek. However, the Orleans, Hawkins Creek and Campbell Ridge localities are on matrix lands, and are available for management, subject to mitigations for species' persistence.

The Laytonville locality is on land of unknown ownership, but appears to be privately owned. The Round Valley occurrence is also on private property, although the possibility of extirpation may render the land ownership moot. These occurrences are afforded no protections at present.

CONSERVATION SUMMARY

Sulcaria badia has a scattered distribution throughout its range, which is from central Oregon to northern California. It is known from three habitats: *Quercus garryana* grasslands, mature Douglas-fir/black oak

Table 1: Known localities of *Sulcaria badia* in the Pacific Northwest. UTM coordinates are Zone 10, NAD 27. 6R = Six Rivers herbarium; other abbreviations for herbaria follow *Index Herbariorum*. Empty cells represent unknown or no data.

State	County	Location	UTM E	UTM N	Elevation (ft.)	Most recent observation date	Herbarium	Presumed extant?
CA	Mendocino	Round Valley	477xxx	4404xxx	1420	1897	US	no
CA	Mendocino	Laytonville	457xxx	4395xxx	1700	1997	HSC	yes
CA	Humboldt	Orleans	455xxx	4570xxx	1580	2006	6R	yes
CA	Lake	Lake Pillsbury	505xxx	4359xxx	1820	2002	herb. Toren	yes
CA	Trinity	Hawkins Creek	456xxx	4524xxx	1247	2005	6R	yes
CA	Trinity	Campbell Ridge	450xxx	4528xxx	1981	2004	6R	yes
CA	Lake	Bucknell Creek	498xxx	4354xxx	1960	2002	none	yes
OR	Benton	Philomath			330	1934?	OSC	no
OR	Benton	Corvallis	479xxx	4934xxx	230	1997	OSC	yes
OR	Benton	W of Philomath	470xxx	4931xxx	330	2003	OSC	yes
OR	Douglas	Reedsport	411xxx	4839xxx	131	1996		yes
OR	Jackson	Berry Creek	519xxx	4725xxx	1890	2003	OSC	yes
OR	Jackson	Snider Creek	505xxx	4711xxx	1650	2002	OSC	yes
WA	Clallam	Dungeness	490xxx	5332xxx	33		FH	no

forests, and shore pine/dune communities on the immediate coast in Oregon. Population trends are unknown, although two occurrences are presumed extirpated, one of which causes a 225-mile contraction in its range. Recent discoveries (post-2002) on National Forest lands in northern California have increased *Sulcaria badia*'s presence in California, and it has recently become a Sensitive plant on four National Forests in northern California. These new occurrences are on matrix lands, and as such are vulnerable to project-related disturbance, but their status as Sensitive plants requires that mitigations be written into planning documents.

Specific Conservation Recommendations

Recommended Global Rarity Rank: G2G3
Species is narrowly distributed in the Northern Hemisphere, restricted to the Pacific Northwest. Localities adjacent to agricultural lands face loss of vitality through declining air quality. Seven of eleven localities consist of fewer than five occupied trees.

Recommended Global Threat Rank: .2
Possibly sensitive to air pollution, and some localities are adjacent to agricultural lands, making these vulnerable to human activities.

Recommended Local Rank (CA): S2S3.2
Small number of sites (six localities, nineteen occurrences), only two localities have large number of sites and/or occupied trees, only one of these localities is on Federal lands.

Recommended Local Rank (OR): S2.2
Small number of sites (five localities, greater than five sites), only two sites have large number of occupied trees, both of these sites are on Federal lands.

Recommended Local Rank (WA): SX
One historical occurrence in Washington state, which is presumed extirpated.

Recommended CALS List (CA): 3
Sulcaria badia appears to be rare throughout its range, and that range is narrow. Partially vulnerable, since one large locality is on Federal land, but abundances are typically low for a given occurrence.

Recommended CALS List (OR): 3
Same considerations as California, especially around Medford BLM.

Recommended CALS List (WA): 1A
One historical site in Washington state, which is presumed extirpated.

Relevant Experts And Knowledgeable Local Botanists

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Weaverville, CA 96093

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Toren, D. 2004. Personal communication. Mendocino National Forest.

Sulcaria badia and *Bryoria tortuosa* drape branches of an oak tree in roughly equal amounts, where *S. badia* was rediscovered in the Laytonville area, winter 1997. Photography by Eric Peterson.

Calicium adspersum, Sponsorship for the CALS Conservation Committee

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EXECUTIVE SUMMARY

Calicium adspersum is a pin-lichen with a yellowish pruina over the mazaedium, which combined with the black spore mass gives the head of the ascomata a dark-greenish cast. The species has a large global range and is known in North America from the Pacific Northwest in areas of maritime-influenced cold climates. The species appears to be quite infrequent through its range within North America and at least some parts of Europe. Only a single location is known at present for the species in California, on state lands with substantial management to retain the old-growth forests currently at the site. Given that there is only a single known site in California and that appropriate habitats for this sporadically occurring species are themselves limited within California, the species qualifies for ranking and listing by the California Lichen Society and should meet criteria for protection under the California Environmental Quality Act. Recommendations are for rank G4.3 S1?.2 and list 2. Suggested conservation is for assessment of the population at the known site and management of forest and understory to provide continuity of conditions around the site and that care should be taken with prescribed fire to not burn the trunks of trees inhabited by the species.

TAXONOMY

Accepted scientific name: *Calicium adspersum* Pers.

Common name: none established; suggest "spiral-spored guilded-head pin lichen"

Type specimen and location: Lectotype housed in L, type location is Germany. (see Tibell 1999)

Synonyms: none known.

DESCRIPTION

Adapted from Tibell (1999): Lichenized calicioid. Thallus grayish, generally verrucose. Ascomata a stalked mazaedium, 0.8 – 1.4 mm tall, with a yellow pruina over on the excipular rim and mixed with the spores covering the mazaedium (sometimes faint) and causing a greenish cast to the mazaedium. Spores 13-17 um x 6-8 um, with a distinctive ornamentation of spirally arranged ridges. Figure 1 (Figure C on back cover).

Note: Although the anatomy of Pacific Northwest specimens matches well with European specimens, the general morphology may be distinct (Tibell pers. comm., email Dec. 2006), suggesting the possibility of phylogenetic divergence, perhaps at a subspecies level. Genetic study will be considered if new specimens become available.

Similar species and distinguishing characteristics: The genus is distinguished from other calicioid genera most easily by the stalked ascomata with black spores (under dissecting scope) and a

Figure 1 (repeated in color on back cover). *Calicium adspersum* Pers. Photo from an Oregon specimen, EBP #2737 (hb. Peterson). This specimen shows a faint mixing of yellow pruina into the mazaedium, resulting in a greenish appearance. Scale bar = 1 mm. Photography by E. B. Peterson.

lichenized thallus (which may be immersed in the substrate in other species). This is the only species of *Calicium* currently known to occur along the Pacific Coast with a yellow pruina. *Calicium trabinellum* occurs in more continental climates and has yellow pruina, but the spores are roughly cracked with only a faint striation early in development. Several species of *Calicium* occur along the pacific coast with spirally ornamented spores, but lack yellow pruina (note: in some specimens the pruina may be sparse forming only a greenish cast to the mazaedium). In particular, *Calicium lenticulare* may have a similar stature, and somewhat similar thallus; however that species has no hint of yellow pruina in the mazaedium and the thallus generally has a bluish to greenish cast, a glossy appearing cuticle, regular dispersion of the verrucae, and a different spore ornamentation.

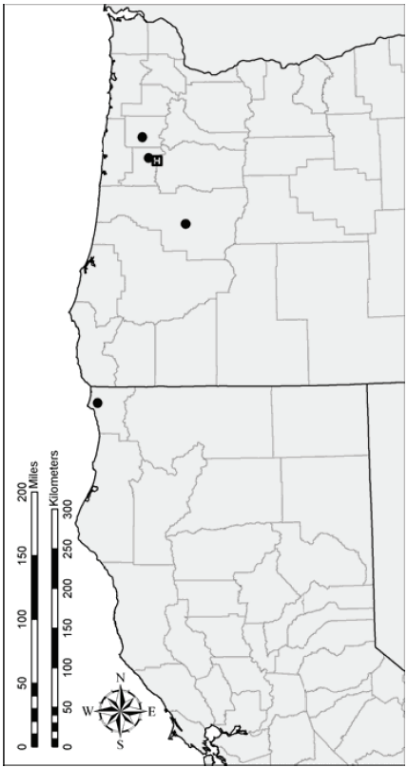
BIOLOGICAL CHARACTERISTICS

Growth form: crustose (calicioid)
Reproductive method: sexual spores
Dispersal agents: undetermined. Two schools of thought exist: (1) stalked mazaedia raise spores above an air-flow boundary layer and are thus wind dispersed; (2) stalked mazaedia raise spores to brush against arthropods or birds which then disperse spores directly to similar habitats. The second concept is currently most popular.
Substrate and specificity: In North America, the species seems rather restricted to aged bark of conifers (typically old-growth trees over 200 years of age). Host conifers include *Abies grandis, Pseudotsuga menziesii, Sequoia sempervirens,* and *Thuja plicata*. However, in Scandinavia, the habitat is primarily bark of ancient *Quercus* trees.
Habitat and specificity: Given that few sites are known for the species in North America, it is difficult to make general habitat statements. Based on the limited evidence, the species appears to be restricted in North America to cool-humid, stands with relatively dense trees but sparse understory.
Pollution sensitivity: unknown
Ecological function: unknown

GEOGRAPHY

Global: This species has a broad global range and is known from Europe, and North America as well as Australia and New Zealand, though specimens from the southern hemisphere have been placed in a distinct subspecies (Tibell 1987). Frequency of the species outside of North America is unknown to me, however, it is red-listed in two Scandinavian nations. Within North America, it is known from California to British Columbia.

Local: Known within California by only a single specimen from a *Sequoia sempervirens* stand in Del Norte County. In Oregon, the species has been found at 4 sites, although one of those specimens is an old collection from an unusual habitat and should be reexamined in light of the substantial changes in calicioid taxonomy since the early 1970s. There is one site known in Washington state. In British Columbia, it known from about 5 sites. All sites except for the suspect Oregon specimen, are old-growth conifer forest in relatively cool-humid stands with maritime climatic influence. Site information



Map of known distribution within northern California and Oregon. Back-filled H marks the collection reported by Pike (1973), a specimen with suspect identification and of an age now considered 'historic' by Natural Heritage methodology.

here is based on Pike (1973), Tibell (1975), Noble 1982, Peterson & Rikkinen (1999), Goward (1999), Rikkinen (2003), and Goward (pers. comm., email Sept. 2006). The actual frequency of occurrences probably increases northward from California to British Columbia. Old reports of the species in Arizona and other parts of the southwest (e.g. Goward 1999) are likely mis-identifications and have not been acknowledged in the more recent and comprehensive work in that region (Nash 2004).

POPULATION TRENDS

It is reasonable to presume that the species has experienced significant historical declines due to logging of old-growth trees throughout it's world-wide range. However, such logging has slowed in North America and Europe. In North America, fire in the limited remaining old-growth forests may now be a greater threat to the species.

THREATS

History: Logging has removed vast areas of historically old-growth forests in North America and Europe that were appropriate habitat for this species.

Future: The pattern of wildfires in western North American forests has been trending toward more geographically extensive fires. Such fires may now be a greater threat to old-growth dependent lichens, although a better understanding of the relationship of fire intensity to lichen survival on trunks and in the canopy is needed. On the other hand, lack of fire may be a threat as well, as this species occurs rather low on the trunk of old trees and thus could possibly be threatened by overly dense understories. Trunk inhabiting lichens, as many calicioids are, may be best suited to a frequent, light fire regime that clears understories without significantly burning trunks..

PROTECTION

Calicium adspersum is red listed in Denmark and Finland. It is currently included on the Sensitive Plant Species list by the U.S. Forest Service in the Pacific Southwest region. The single known site in California is in the Jedediah Smith Redwoods State Park, which should be well protected. If it is found in additional sites in California, the sites should be protected from logging, and current understory conditions should be maintained as best as possible without directly harming the occurrence (e.g. care should be taken to not burn the tree trunk with any prescribed fire).

CONSERVATION STATUS SUMMARY

The species has a large global range and is known in North America from the Pacific Coastal regions from California to British Columbia. However, the species appears to be quite infrequent through its range within North America and at least some parts of Europe. It is currently listed as a Special Status Species for the Six Rivers National Forest. The single known site for the species within California is on state lands with substantial management to retain the old-growth forests currently at the site. Given that there is only a single known site in California and that appropriate habitats for this sporadically occurring species are themselves limited within California, the species qualifies for ranking and listing by the California Lichen Society and should meet criteria for protection under the California Environmental Quality Act.

SPECIFIC CONSERVATION RECOMMENDATIONS

Recommended Global Rarity Rank: G4

The species has a broad global range, though it occurs quite infrequently through some of that range.

Recommended Global Threat Rank: .3

Although the species is infrequent through much of its range, extinction-causing disturbances throughout the range within a short period of time are very unlikely.

Recommended Local Rarity Rank: S1?

The species is known from only a single site in California. It is possible that an uncertain number of additional sites may be found, thus the inclusion of a question mark in the rank. However, I do not believe there is enough uncertainty that the rank should cover a range (e.g. S1S2). Current knowledge of habitat requirements would suggest that the habitat is limited in California. Additionally, in Oregon, where appropriate habitat is much more abundant and research on pin-lichens has been much more intensive, only 3-4 sites are known. Thus it is unlikely that additional sites in California will be numerous.

Recommended Local Threat Rank: .2

Although the species occurs in California in a well-protected state park, it's occurrence on the lower

trunk of trees could subject the population to stochastic events such as fire.

Recommended List: 2
The species is rare within the portions of its range that lie within the United States. However, given that it is not red-listed in Sweden implies that it is significantly less rare in at least one portion of its range.

Recommended conservation/management actions: A site assessment is warranted to determine the extent of the population and the current understory conditions surrounding inhabited trees. Recognizing that understory undergoes successional changes on a short time scale relative to overstory trees in redwood forests, understory conditions at the site should be managed to provide an appropriate mosaic of successional stages within and around the population to ensure a continuity of proper habitat and understory conditions around the site. If prescribed fire is to be used in site management, then care should be taken to avoid burning the trunks of inhabited trees.

RELEVANT EXPERTS AND KNOWLEDGEABLE LOCAL BOTANISTS

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LOCATION/SPECIMEN LIST

From Peterson and Rikkinen (1999) and Rikkinen (2003): California, Del Norte County, old-growth *Sequoia sempervirens* forest, Jedediah Smith Redwoods State Park, on *S. sempervirens* (live tree, trunk, bark), 41º48'N, 124 º 05'W, elevation ca. 200 m, Rikkinen 98232 (H).

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California Page

Kerry Knudsen
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"Two Brown-Spored *Pertusaria* from south-western North America" by Imek Schmitt, H. Thorsten Lumbsch, and Charis Bratt in Lichenologist 38:5 (2006) describes two new species from Baja and the Channel Islands Of California. To see the brown spores are quite striking. *Pertusaria islandica* Bratt, Lumbsch & Schmitt is known from Baja Sur and San Miguel Island. Both epihymenium and spore walls turn violet in K. *Pertusaria occidentalis* Bratt, Lumbsch & Schmitt is also known from Baja and San Miguel Island as well as from San Nicholas Island. It contains xanthones and grows on carbonate substrates.

Silke Werth was awarded the Mason Hale award for her doctoral thesis on dispersal and persistence of the epiphytic lichen *Lobaria pulmonaria* in a dynamic pasture-woodland landscape. She recently published a paper on the dispersal ecology of *Lobaria pulmonaria* in Ecology, "Quantifying dispersal and establishment limitation in a population of an epiphytic lichen". She will continue her work on the phylogeography of *Ramalina menziesii* through fall 2007. An upcoming paper on local genetic structure of *Ramalina menziesii* in southern California should be published in 2007. Check her web page http://www.eeb.ucla.edu/Faculty/Sork/Werth/ for a poster showing initial results.

Vol. 3 of Lichen Flora of the Greater Sonoran Region is currently delayed while the final treatments on *Arthonia* and *Aspicilia* are completed. It is expected out in Spring, 2007. Thomas Nash is also working on a new edition of *Lichen Biology.*

Bruce McCune and Roger Rosentreter will be publishing in 2007 a book on biological soil crusts. It will be illustrated with color pictures of each of the lichens that occur in these crusts. The pages seen were excellent. The book will be published by Northwest Lichenologists and will be the first in a series of monographic books they hope to publish at reasonable prices.

Frank Bungartz has produced a new Sonoran lichen calendar for 2007 and copies are probably still available from the California Lichen Society, although at last report they were moving fast. http://californialichens.org/forsale.html

The database of the lichen herbarium at the University of California at Riverside is now online and it is up-dated monthly http://sanders5.ucr.edu /lichensflat_index.php

Robin Schroeder, assistant curator at ASU Lichen Herbarium, gave birth to a son named Torin William Schroeder. He was born on Labor Day weekend on Sept. 1st, 2006.

Jennifer Riddell has a BS in Botany from Humboldt State University, and is currently working on her masters at ASU in Plant Biology with Tom Nash. Her research focuses on using lichens as biomonitors, and their physiological responses to air pollution. Jen is doing part of her research at the University of California at Riverside this next year using collections of *Ramalina menziesii* from the UC Sedgwick Preserve. Her email is Jennifer.Riddell@asu.edu

Chaenotheca ferruginea photographed on CALS field trip near Yuba Pass, CA. Photography by Eric Peterson.

News and Notes

CALS FIELD TRIP TO CASTLE ROCK STATE PARK LOS GATOS, SANTA CRUZ COUNTY, CALIFORNIA OCTOBER 21, 2006

Field trip participants met in the parking lot at the main park entrance off Skyline Blvd. at 10:00. There we found our trail head at an elevation of 3090 feet. Elevation change was not significant along our route, however, we did experience a distinct change of habitat as we drew closer to Goat Rock. Adding to the overall ambiance was the knowledge that we could well be treading in the very footsteps of A.W.C.T. Herre, author of "The Lichen Flora of the Santa Cruz Peninsula".

Our trail commenced along a seasonal creek heavily shaded with Douglas-fir, California bay, madrone, tanoak, and coast live oak. Most tree trunks and many rock surfaces were covered with a thick blanket of moss. There was a formidable under story of blackberry and poison oak. Needless to say, we stuck to the trail. We passed several large sandstone formations full of weird pockets and caves. Just before arriving at our lunch destination, Goat Rock, the trail opened into chaparral (chamise, toyon, coffeeberry, manzanita) and continued along a west facing ridge affording beautiful views across the crests of the Santa Cruz Mountains, and out to the Monterey Peninsula and Bay.

Of particular note was the abundance of *Pseudocyphellaria anthraspis* (Ach.) H. Magn. Interestingly, we noticed at several sites, moss covered parallel tree trunks separated by less than half a meter. One trunk would have many large mature fruiting *P. anthrapsis* thalli. On a parallel trunk, there would be a patch of abundant immature thalli poking through the moss, all less than a centimeter and a half in length. One could imagine a very successful spore dispersal event resulting in this mass of tiny young thalli directly facing the trunk with the adults.

The field trip was attended by the following individuals: Susanne Altermann, Sara Blauman, Michelle Caisse, Tom Carlberg, Bill and Gisela Evitt, Bill Ferguson, and Judy Robertson.

Collecting is not allowed in the park. The following list of 50 species is based on morphological characteristics observed on site.

Cladonia chlorophaea (Flörke ex Sommerf.) Sprengel
Cladonia coniocraea (Flörke) Sprengel
Cladonia macilenta var. *bacillaris* (Genth) Schaerer
Collema furfuraceum (Arnold) Du Rietz
Collema nigrescens (Hudson) DC.
Dermatocarpon miniatum (L.) W. Mann
Diploschistes scruposus (Schreber) Norman
Evernia prunastri (L.) Ach.
Flavopunctelia flaventior (Stirton) Hale
Hypogymnia imshaugii Krog
Hypogymnia tubulosa (Schaerer) Hav.
Kaernefeltia merrillii (Du Rietz) Thell & Goward
Koerberia sonomensis (Tuck.) Henssen
Lecanora muralis (Schreber) Rabenh.
Leptochidium albociliatum (Desmaz.) M. Choisy
Leptogium gelatinosum (With.) J. R. Laundon
Leptogium lichenoides (L.) Zahlbr.
Letharia vulpina (L.) Hue
Melanelia subolivacea (Nyl.) Essl.
Nephroma helveticum subsp. *sipeanum* (Gyelnik) Goward & Ahti
Normandina pulchella (Borrer) Nyl.
Ochrolechia oregonensis H. Magn.
Pannaria sp. Delise
Parmelia hygrophila Goward & Ahti
Parmelia sulcata Taylor
Parmelina quercina (Willd.) Hale
Parmotrema chinense (Osbeck) Hale & Ahti
Peltigera collina (Ach.) Schrader
Peltigera membranacea (Ach.) Nyl.
Peltigera ponojensis Gyelnik
Peltigera rufescens (Weiss) Humb.
Phaeophyscia decolor (Kashiw.) Essl.
Phaeophyscia orbicularis (Necker) Moberg
Physcia aipolia (Ehrh. ex Humb.) Fürnr. var. *aipolia*
Physcia tenella (Scop.) DC.
Physconia isidiigera (Zahlbr.) Essl.
Platismatia glauca (L.) Culb. & C. Culb.
Platismatia herrei (Imshaug) Culb. & C. Culb.
Platismatia stenophylla (Tuck.) Culb. & C. Culb.
Pseudocyphellaria anomala Brodo & Ahti
Pseudocyphellaria anthraspis (Ach.) H. Magn.
Punctelia subrudecta (Nyl.) Krog
Ramalina farinacea (L.) Ach.
Schaereria corticola Muhr & Tønsberg
Sphaerosphorus globosus (Hudson) Vainio
Umbilicaria phaea Tuck.

[*continued on next page*]

Usnea arizonica Mot.
Usnea cornuta Körber
Waynea californica Moberg
Xanthoria candelaria (L.) Th. Fr.

Contributed by Sara Blauman, Judy Robertson, and Tom Carlberg.

FUNGUS FAIR 2006

CALS sponsored a display again this year at the San Francisco Mycological Society's annual Fungus Fair at the Oakland Museum. The theme was 'Lichens as Air Quality Indicators'. Michelle Caisse organized and coordinated the display. She developed a set of three posters presenting information abstracted from D. H. S. Richardson's Pollution Monitoring with Lichens and Bruce McCune's Macrolichens of the Pacific Northwest, with photos of indicator species contributed by Richard Doell and Judy Robertson. There was also a good number of specimens available for viewing with stereo-microscopes and magnifiers. The specimens, contributed by Sara Blauman, Michelle Caisse, Tom Carlberg, and Judy Robertson, were labeled with identification, habitat, and sensitivity rating. Irene Winston also set up a children's table where the youngest visitors could take a close look at lichens growing on branches and make a drawing. At the sales table, visitors could purchase mini-guides, posters, calendars, note cards, and hand lenses. Reference books were on display for browsing and handouts, including a Lichen FAQ by Sara Blauman, were available for people to take with them. CALS members who staffed the booth to answer questions, assist visitors, and sell products were Suzanne Altermann, Sara Blauman, Michelle Caisse, Janet Doell, Kathy Faircloth, Judy Robertson, and Irene Winston.

We were lucky to have an entire bay of approximately 20 feet square to ourselves this year providing plenty of space for visitors to approach the display and spend time. The posters and handouts allowed visitors to be self-directed, freeing us to answer questions, which varied from basic to insightful to unusual. The most common was "What do lichens have to do with fungi?", a natural given the venue, and a natural point of departure from which to discuss lichens. I had several very interesting conversations about the reproductive biology and ecology of lichens which stretched the limits of my knowledge. I definitely plan to learn more before next year's Fungus Fair. Some budding lichenologists used our display as an opportunity to practice their lichen identification. The most common reaction, though, was simple delight at the beauty and variety of the specimens. "Wow, this is cool. Look at this, mom!" "That really *is* cool."

The children's table, still evolving in its second year now, was a success. Kids from 2 to 9 dove into a variety of ways to look at nature. There was a live fern, a eucalyptus branch with pods, and some lichen-covered branches for the kids to examine and draw. Some kids were really interested in the magnifiers, using them to look at a lichen branch or trying them on as eyeglasses. They generally preferred drawing with pens over crayons. The varying abilities of kids of similar age was striking. Parents appreciated having an activity for their kids. We will learn with time the best way to work this table, but it is a definite enhancement to the CALS display.

During my day at the Fungus Fair, I felt very happy to be in the midst of a lively crowd who were all there because of a love of nature, whether that love was expressed artistically, intellectually, or only by their presence. One visitor epitomized the experience for me, a four year old child whose mother reported that he wants to become a scientist. With his mother's help, he observed with more seriousness and dedication than one would think possible at his age, first the branches at the children's table and then the labeled specimens under a scope. As his mother was leading him away from the CALS specimen display to the next exhibit, he protested, "No, I wanna look at *all* of them."

Visit CaliforniaLichens.org to see photos of the CALS display at Fungus Fair 2006.

Contributed by Michelle Caisse and Judy Robertson.

A portion of the CALS display at 2006 Fungus Fair. Photography by Judy Robertson

Upcoming Events

CALS ANNUAL MEETING, POTLUCK AND BIRTHDAY CELEBRATION WITH PRESENTATION BY CALS CONSERVATION CHAIRPERSON, ERIC PETERSON
FEBRUARY 3, 2007

The condominium development at Brickyard Landing, the home of Janet and Richard Doell, was opened in 1985. At that time, there were no lichens on any of the trees or buildings. Now, 21 years later, there are a number of them. Join us this Saturday to find out what lichens have grown in 21 years. It will be interesting to see if we can determine how fast or slow this growth as been. We may travel to a nearby park which was also devoid of lichens 21 years ago, then go to the site where last year, Kerry Knudsen and Jim Lendemer found the lichenicolous fungus *Sarcopyrenia bacillosa*, which had not been collected in over a hundred years.

Meet at the Clubhouse at 1 PM. We will return by 4 pm. The potluck dinner will start at 5 PM. General meeting at 6:30. We are hoping to have a presentation by Eric Peterson, Chairperson of the CALS Conservation Committee at 7 PM. Look for more information on the CALS Website. Please bring a favorite dish to share. CALS will provide drinks, dessert, and tableware.

Directions to Brickyard Landing Clubhouse
From Marin: Drive east on 580 and come across the San Rafael-Richmond bridge. Take the second exit, Canal Blvd., and turn right or south onto Canal. Continue on Canal about half a mile until the divide in the road ends and the road narrows and bends slightly to the right. Slow down and look carefully for Seacliff Drive which heads off to the right. Head up over the hill and stay on this road (Brickyard Cove Rd.) past one stop sign. You will soon come to a group of five large condominiums on your right. Drive in at the main entrance on Brickyard Way, turn right almost immediately onto Brickyard Cove Lane, drive past the tennis courts and park. Enter at the swimming pool gate. The clubhouse is straight ahead.

From the East Bay: Drive west along 580 to Canal Blvd., turn left onto Canal and proceed as above.

LICHEN FIELD TRIP TO SUTTER BUTTES
SUTTER COUNTY
FEBRUARY 10-11, 2007

Yuba City's western horizon is dominated by the Sutter Buttes, renowned for being the "Smallest Mountain Range in the World." The range is actually circular with a diameter of 10 miles and covers an area of about 75 square miles. The mountains are the remnants of a volcano that has been dormant for over a million years.

Before modern levees and dams were built to contain the rivers, winter storms and spring run-off frequently turned the Sacramento Valley into an inland sea, making the Sutter Buttes an island refuge for Indians, settlers and wildlife.

The Buttes have had many names over the years. The Maidu Indians called them "Histum Yani" which translates as, "Middle Mountains of the Valley". Pete and Margit Sands, our hosts for this weekend foray, are part of the Middle Mountain Foundation, a Sutter Buttes land trust. We started our exploration of this area in February 2004. We collected lichens for one day and were rained out on the second. Our trip for February 2005 was cancelled because of rain. We will try again on February 10-11, 2007. We have also reserved the following weekend (Feb. 17-18) in the case of inclement weather.

If you are interested in attending, contact Judy Robertson at jksrr@aol.com

Look for more information on the CALS Website

NORTHWEST LICHENOLOGISTS MEETING WITH THE NORTHWEST SCIENTIFIC ASSOCIATION
VICTORIA, CANADA
FEBRUARY 22-24, 2007

Lichen and bryophyte symposium: Thursday, Feb. 22.

Sessions will be formulated in relation to contributed papers. An award will be given for the best student paper.

Short field trip and afternoon workshop (topic to be determined): Friday, Feb. 23

Field trip of lichens and bryophytes of the Victoria area (possible trip to salt spring island): Saturday, Feb. 24

SO BE FREE GATHERING
MARCH 27-30, 2007

This gathering is for moss enthusiasts, but the area would make a great lichen field trip.

The meetings will be at the American Museum of Natural History's Southwestern Research Station, Cave Creek Canyon, Chiricahua Mountains, southeastern Arizona.

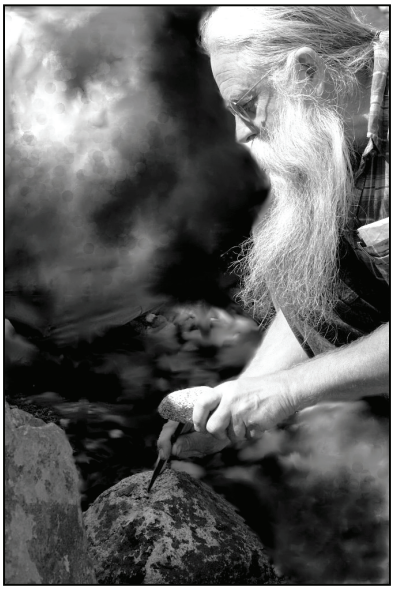
If you are interested in attending make our reservations with John Spence at John_Spence @nps.gov. Reservations must be made by January 31, 2007. John's address is P.O. Box 833, Page, AZ 86040-0833

ONGOING LICHEN IDENTIFICATION WORKSHOPS
MARIN COMMUNITY COLLEGE
ROOM 191 IN THE SCIENCE CENTER
2ND AND 4TH FRIDAYS

We encourage you to attend these enjoyable workshops at the Community College.

Dr. Paul DiSilva has graciously allowed us to use the classroom and scopes. Patti Patterson organizes the logistics. We bring our own lichens and work with each other to identify them. Workshops take place on the 2nd and 4th Fridays of each month, between 5:30 and 9:00 PM. Parking at the college is $3.

President's Message



As you see from the articles in this Bulletin, our Conservation Committee has been working and the report articles are the culmination of their efforts. We had considered including only summaries in the Bulletin but decided to publish the reports in entirety, as they represent a comprehensive review of the species in question and are thus of value to the scientific community.

We adopted the categorization of rarity and endangerment that had been developed by groups like the Native Plant Society, added a step by step process for information collection and review to get the best consensus with the latest knowledge of particular species that we think are rare and/or endangered.

Meanwhile I have barely been in California the past few months. Partly I have been searching for recommendations of the best herbarium database and collections cataloging process for the Harry Thiers Herbarium at San Francisco State where I have worked the past year. It all began last summer while traveling to visit friends. I stopped off at herbaria in Logan UT, Fort Collins and Greeley CO, and Lansing MI to see how they do their computer databases. At the beginning of August I was momentarily in California and at three days of 'cyberinfrastructure' sessions at the Botany 2006 conference in Chico CA. Then in October I was off and running again -- I just couldn't miss the week long conference of TDWG (taxonomic database working group, pronounced "tad-wig") at the Missouri Botanical Garden in St Louis. TDWG is an international group working to make computers around the world efficiently interchange of biological collections and observations information. It is becoming increasingly more important for conservation groups and data depositories like herbaria around the world to share their information in order to define population trends and identify rare and endangered species before they go extinct. Much of knowledge of particular species in a particular place (like say, California) resides in specimens scattered throughout herbaria elsewhere on the planet and we need a more efficient data interchange process for the world's biological information to obtain it. If collections information is not in an online database it is

effectively 'missing information'. There is a decree "2020 vision" to have collections and observation data in computer databases and available online by the year 2020 http://herbaria.science.oregonstate.edu/?q=/node/26.

A subsequent benefit for taxonomists is that if the online data is detailed enough (including good photos of specimens, etc.) it is often unnecessary to send specimens hither and yon, saving wear and tear on (especially valuable 'type') specimens, and researchers get to 'see' the specimens immediately.

There is an alphabet soup of organizations and data recording and interchange standards - TDWG, GBIF (Global Biodiversity Information Facility), DiGIR (Distributed Generic Information Retrieval), Darwin Core (the basic dataset used by DiGIR), ABCD (Access to Biological Collection Data), TAPIR (TDWG Access Protocol for Information Retrieval) and a host of database structures used in various herbaria - BRAHMS (used especially in Europe), EMu (used by the New York Botanical Garden), Index Kentuckiensis (used especially by many vascular plant herbaria), and probably the latest and best so far SPECIFY (developed at Kansas University/Lawrence KS). For more about any of this, just put some of the terms into Google and you will find more than you ever wanted to know. I hope by the next Bulletin I can have an overview report on the latest of all of this herbarium database/network development.

Latest but not least, I attended a weekend meeting of NorthEast Herbaria Nov 14-15 at Yale/New Haven CT where people networked for techniques on how to get their collections information databased and online. While in the neighborhood (only about an hour to New York City), I was treated by Barbara Thiers (now director of the New York Botanical Garden herbarium) to observe how they image their fungal type specimens. See http://sciweb.nybg.org/science2/VirtualHerbarium.asp, and for an example of the results, one of Harry Thiers's type specimens there http://207.156.243.8/emu/vh/specimen.php?irn=559865. I think NYBG has the process down to an optimum.

By the way I saw Susanne Altermann, our student grant recepient giving an excellent poster presentation "Geographic structure of fungal-algal partnerships in a widespread lichen" at the Botany 2006 conference in Chico on her *Letharia* Phylogeography study. She was surrounded by a whole group of eminent lichenologists as she explained her latest work. For more on this, visit her website http://bio.research.ucsc.edu/people/goff/letharia.htm.

Meanwhile back home, the CALS exhibit "Lichens - Indicators of Air Quality" at the MSSF Fungus Fair this year was another success. Photos at http://californialichens.org/fieldtrips/FungusFair/judy/. And there were more fieldtrips and workshops. As 2007 is my last year as president (three terms *ought* to be enough!), I urge you to start thinking of who you would like to supercede me.

Have a good year, and happy lichenizing,

--Bill Hill -aropoika@earthlink.net

A Sincere Thanks

The California Lichen Society would like to thank our Benefactor, Donor, and Sponsor memberships that arrived since the last (June 2006) Bulletin, and acknowledge again our Life Members. Their support helps in our mission of increasing knowledge and appreciation of California lichens and is greatly appreciated.

Sponsors:
E. Patrick Creehan, M.D.

Donors:
Dr. Anne Pringle
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Benefactors:
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Current Life Members:
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Stella Yang & Stephen Buckhout
Kathleen Faircloth
Trevor Goward
Lori Hubbart
Greg Jirak
Dr. Thorsten Lumbsch
Jacob Sigg

The Bulletin of the California Lichen Society

Vol. 13, No. 2 Winter 2006

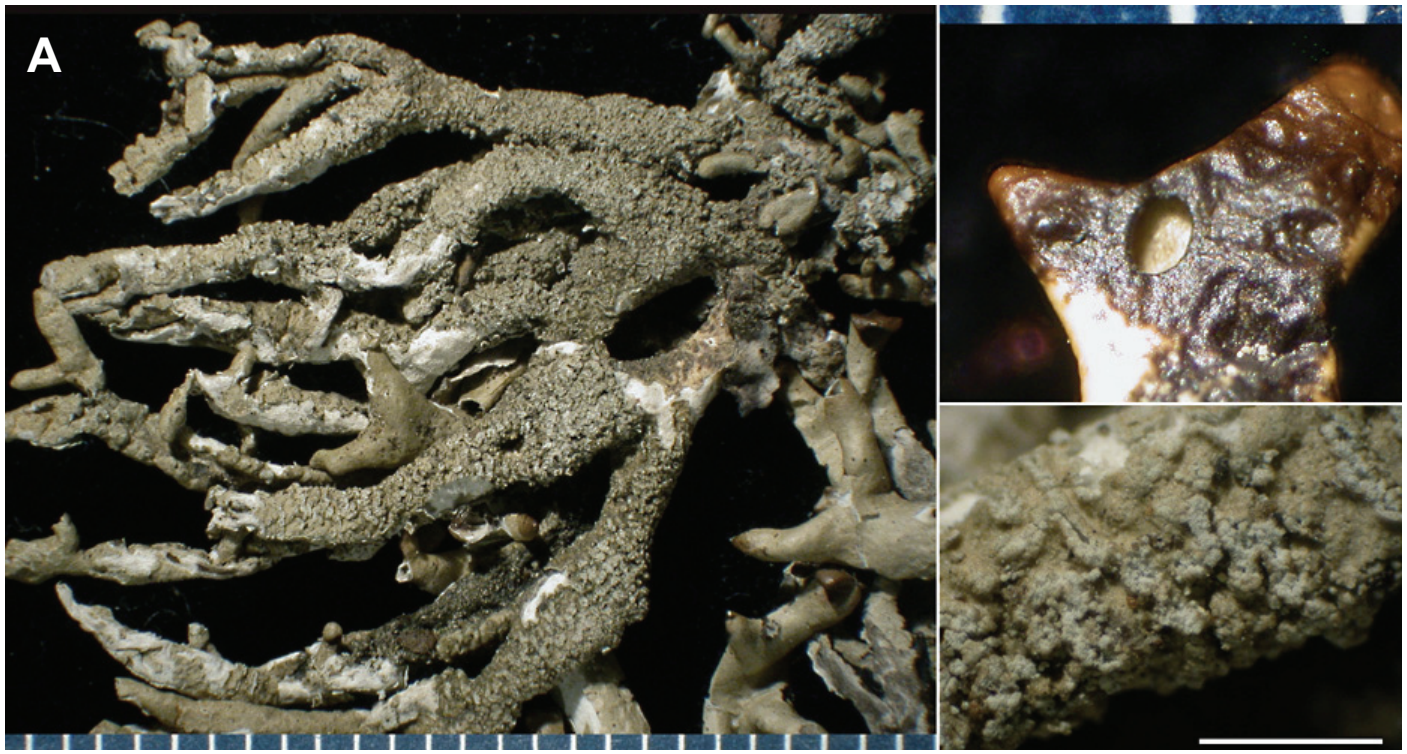
Contents

Back cover:

A) *Hypogymnia schizidiata* McCune. Bratt 3160a from Santa Cruz Island, showing lobes, perforation in lower surface of lobe tip, and schizidia forming on upper surface of lobe. Blue ruler has mm marks. Scale bar in lower right is 1 mm. Photography by B. McCune. See paper on page 42.

B) *Sulcaria badia* Brodo & D. Hawksw. Main branches (left), showing flattened axil and spiraling pseudocyphellae, and twisted branches (right). Photography by T. Carlberg. See paper on page 45.

C) *Calicium adspersum* Pers. Photo from an Oregon specimen, EBP #2737 (hb. Peterson). This specimen shows a faint mixing of yellow pruina into the mazaedium, resulting in a greenish appearance. Scale bar = 1 mm. Photography by E. B. Peterson. See paper on page 51.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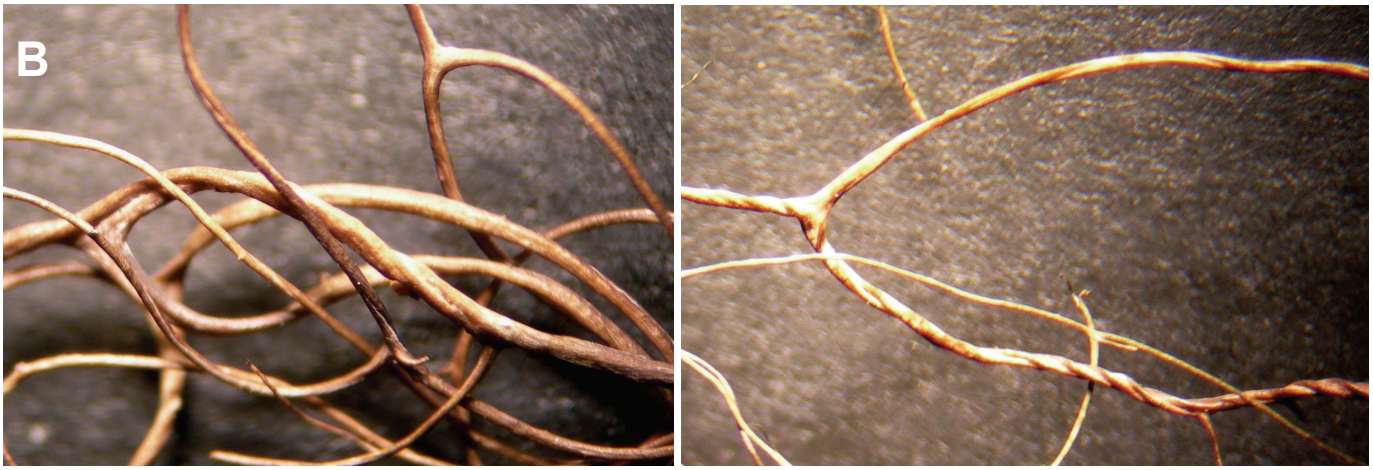
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