

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

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

INTRODUCTION

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

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

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

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

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

future years focusing on other taxa groups.

METHODS

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

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

STUDY AREA

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

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

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

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

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

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

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

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

RESULTS

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

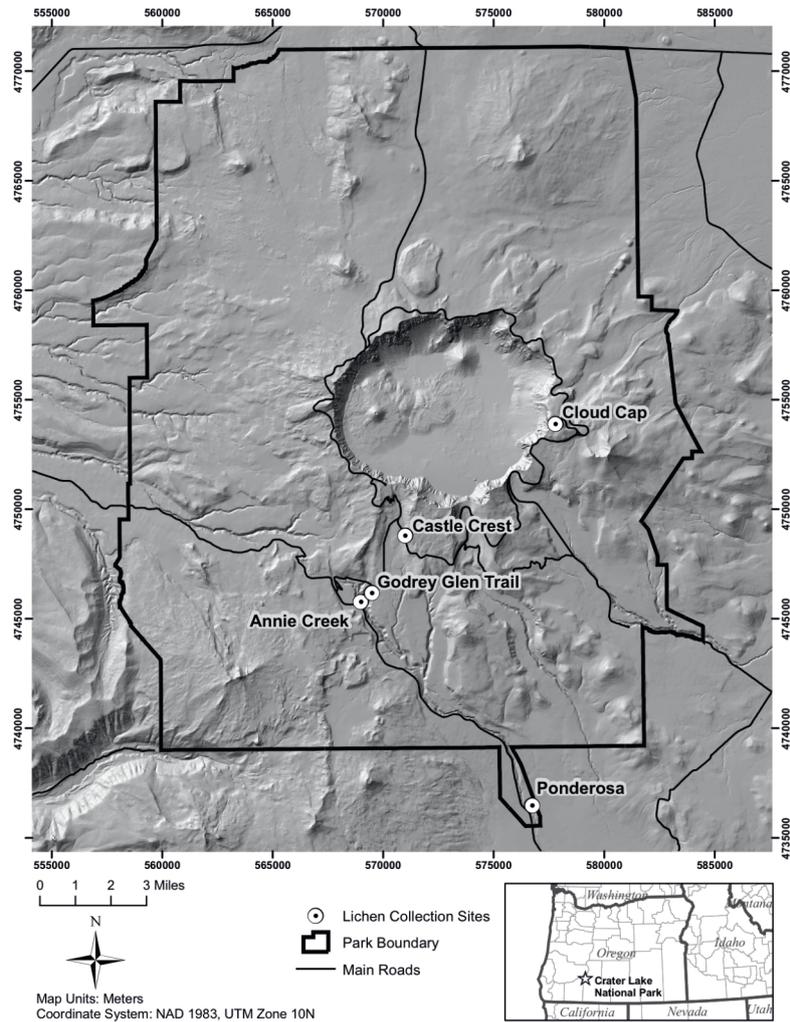


Figure 1. Lichen Bioblitz collection sites within Crater Lake National Park.

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

DISCUSSION

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

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

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

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

ACKNOWLEDGEMENTS

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

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

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

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

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

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

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

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