One-hundred years of change in corticolous macrolichens of Madison, Wisconsin

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Abstract. Increased urbanization often leads to an altered and/or reduced lichen biota. Here we characterize the corticolous macrolichen biota of the Madison, Wisconsin area, and compare the present-day biota with historic collections made in the vicinity during the 1890's. The present-day biota consists mostly of small foliose taxa (16), which frequently occur in urban areas, a smaller number of medium-foliose taxa (13) and a very small number of fruticose taxa (3). Forty-four percent of the taxa collected in the 1890's were no longer found to occur in the area, with the greatest amount of loss occurring in the medium-large foliose (62.5%) and fruticose (40%) guilds. Interestingly, three fruticose taxa, which were thought to have disappeared from the study area, were found in the modern survey.

INTRODUCTION

Massive changes are often revealed when one compares historic and present lichen species inventories. Lichens provide an opportunity to examine historic change as they are influenced by air quality, substrate and light regime, all of which change during urbanization. Industrial and agricultural pollution have had marked effects on lichen species composition, often resulting in a depauperate or drastically altered lichen biota (Hawksworth 1990; van Herk 1999). Substrate characteristics, such as bark pH and moisture-holding capacity, influence lichen establishment, with some species occurring on acidic bark and others on more neutral bark (Culberson 1955; Hale 1955). Consequently, shifts in tree species composition affects the range of available substrates for lichens to colonize. Additionally, changes in tree composition can also affect light and moisture conditions, to which lichens are known to respond (Barkman 1958; Culberson 1955; Hale 1955).

Several historic lichen studies from Wisconsin (summarized in Thomson 2003 and Will-Wolf & Nelsen in press) provide excellent potential for comparative resurveys. One of these involves historic collections made by Lellan Cheney in the 1890's in the Madison, Wisconsin area (south-central Wisconsin). These collections were only recently discovered and the records published (Thomson 1998). Although Cheney's collections were not intended to be part of an exhaustive, floristic treatment of the region, they nevertheless documented the presence of numerous species at that time. Thomson (1998) noted that some of the species collected by Cheney no longer existed at various regional scales including the city, county and state. To better understand and demonstrate the magnitude of species loss, a comparative sampling of the corticolous macrolichens in the Madison area was undertaken, which was then compared with the Cheney collections made in the 1890's.

Materials and Methods

In 1999 and 2000, eight sites in and around the city of Madison, Wisconsin were selected and sampled. The five sites located in the city limits were: Picnic Point, Hiestand City Park, the University of Wisconsin Madison Arboretum, Wirth/Worthington City Parks and a residence in University Heights; while the three sites in the vicinity of Madison were: Token Creek County Park in DeForest, Festge County Park in Cross Plains and Cross Country/Palmer City Parks in Verona. The 3 sites outside of Madison were chosen because the effects of air pollution and the urban environment were expected to be less than at locations within the city of Madison. Results of an air pollution study (Nelsen 2000) will be described in a separate publication. Each site was searched for corticolous macrolichen species; a voucher set has been deposited in the Wisconsin State Herbarium (WIS).

All taxa were assigned to one of three guilds based on growth form: small foliose, medium-large foliose, or fruticose. Species in this study were compared to all corticolous macrolichens reported from the Madison, WI area in the 1890's listed in Thomson (1998). Species found by Cheney more than 40 miles from the center of Madison, near Blue Mounds, and Sauk and Jefferson counties were excluded. All *Cladonia* species were excluded as well, because these frequently grow on substrates not sampled in this study (lignum, soil).

Results

A total of 31 species were found at the 8 modern sites investigated. During examination of one of Cheney's collections, another species, *Candelaria fibrosa* (Fr.) Müll. Arg., was found, a species not included in Thomson's (1998) publication. Here we add this taxon to the list of corticolous macrolichens collected by Cheney in Madison during the 1890's (Table 1). A checklist of the species with presence at modern locations is given in Table 1, along with the Cheney list. Most species found in this study were foliose; only a small number of fruticose taxa were found. Of the foliose species, 15 were small foliose, and14 were medium-large foliose. Although nearly equal numbers of species were found in these two guilds, the small foliose species were found more frequently, with seven species being found at seven or more sites, compared with only one large foliose taxon that occurred at seven or more sites. Among the small foliose taxa, *Candelaria concolor*, *Hyperphyscia adglutinata*, *Phaeophyscia pusilloides*, *Phaeophyscia rubropulchra*, *Physcia millegrana*, *Physciella chloantha* and *Xanthomendoza fallax* were the most common species, occuring at nearly all sites sampled. Among the rarer small foliose taxa were: *Hyperphyscia syncolla*, *Phaeophyscia adiastola*, *Phaeophyscia hirsuta* and *Physcia adscendens*. *Flavoparmelia caperata*, *Parmelia sulcata*, *Physcia stellaris* and *Punctelia rudecta* were the most common among the medium-large foliose guild, while *Flavopunctelia flaventior*, *Flavopunctelia soredica*, *Melanelixia subaurifera*, *Myelochroa aurulenta*, *Parmotrema hypotropum*, *Physcia aipolia* var. *aipolia*, *Physconia perisidiosa* and *Punctelia bolliana* appeared rarer. *Physcia aipolia* var. *aipolia* is most likely not rare in the study area and may have been confused with *P. stellaris* in the field. The fruticose taxa appeared to be quite rare, with only three species being found. The most abundant of these was *Ramalina americana*, which was found at three sites.

Of the 18 taxa collected in the 1890's, ten (56%) were found to still occur in the area. Nearly all of the small foliose species collected by Cheney were found again (80%), while only 60% of the fruticose taxa and 37.5% of the medium-large foliose species were refound. One medium foliose lichen, *Myelochroa galbina*, was not found in the study area, but is still known from south-central Wisconsin (Will-Wolf et al. 2005), and should be looked for in the Madison vicinity. Even if this were included, it would not change the fact that several medium-large foliose taxa have been lost.

Interestingly, the three fruticose taxa found in this study were thought to no longer occur in or near the study area (Thomson 1998). *Ramalina americana*, which was no longer thought to occur in the city (Thomson 1998), was found at three locations: in the city (UW-Arboretum), just past the city limits (Token Creek Park) and west of Madison (Festge Park). Similarly, *Evernia mesomorpha* was previously thought to no longer occur in Dane county (Thomson 1998), but was found once in this study at the UW-Arboretum. Most interesting was the occurrence of *Teloschistes chrysophthalmus*, which was found at Festge Park, growing on the branches of a young *Quercus macrocarpa* Michx. atop a ridge

overlooking a county highway. Apparently no collections of this species had been made in Wisconsin since 1892, when Cheney found it southeast of Madison, WI and in 1893 when Beald and Huell collected it on the south side of Lake Monona. There is a record in the literature (Rentz & Lappley 1924) from 1924, but no specimen was found in WIS. The report from the current study is discussed by Nelsen (2000, 2005).

DISCUSSION

The degree of species loss is troubling. Forty-four percent of the species collected by Cheney no longer occur in the Madison area. These taxa are mostly consistent with those listed by Thomson (1998). Several of the species found in this study, such as *F. caperata*, *H. adglutinata*, the *Phaeophyscia orbicularis* group, *P. aipolia* var. *aipolia*, *P. millegrana*, *P. stellaris* and *P. rudecta*, are known to be somewhat tolerant of air pollution (Wetmore 1983) and frequently occur in urban or polluted areas (New York City: Delendick 1994; Indianapolis: McCune 1988; Cincinatti: Meininger et al. 1985; Indiana Dunes: Wetmore 1988; Cuyahoga Valley: Wetmore 1989; Chicago: Wilhelm 1998).

While the present corticolous lichen biota in Madison contains nearly as many medium-large foliose taxa as small foliose, the medium-foliose species were encountered less frequently than the small foliose taxa. In a historic comparison of lichens of the Chicago region, Wilhelm (1998) noted that many of the species found in the present study had increased in their abundance in the Chicago area since the 1890's. He further discusses how many small foliose and crustose taxa have replaced large foliose and fruticose species. The findings in this study are consistent with those reported in Wilhelm (1998), with much loss occurring among the medium-large foliose (62.5%) and fruticose (40%) taxa found by Cheney, including the large foliose species *Anaptychia palmulata*, *Platismatia tuckermanii* and *Tuckermannopsis ciliaris* and the fruticose species *Bryoria furcellata* and *Usnea hirta*, all mostly found now in northern Wisconsin (Thomson 2002). In contrast to the amount of loss in these two guilds, less loss has occurred in the small foliose guild (20% lost).

The effects of air pollution combined with habitat destruction and fragmentation have probably led to the decline in abundance of many of these species in southern Wisconsin. If this trend continues, it seems likely that taxa such as the fruticose *E. mesomorpha*, *R. americana*, *T. chrysophthalmus* and large foliose *P. bolliana* will decrease in abundance and may eventually be lost from the area. To preserve diversity, it is recommended that air pollution emissions continue to be reduced, that large, unfragmented forested areas be maintained, and that forests be managed in such a way that tree and shrub density levels are not allowed to become extremely high, as increases in shade are known to contribute to homogenization of the lichen biota (Will-Wolf et al. 2005).

ACKNOWLEDGEMENTS

We would like to thank J. Thomson, for his support and encouragement. M. Leach (UW Arboretum/Northland College), C. Bruner (UW-Natural Areas), F. Paasch (Dane County Parks), R. Hefty (City of Madison Parks), L. Anderson, B. Braun, the UW-Grounds Committee, and the Verona Parks Department are thanked for collecting permits. A. Fryday is thanked for reviewing and improving the manuscript. M. Makholm, M. Trest, C. Andrew and J. Bennett are warmly thanked for discussion, advice and encouragement.

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Table 1. List of corticolous macrolichens found in the vicinity of Madison, Wisconsin by Cheney in the 1890's (in Thomson 1998) and during the present study, with modern sites noted. Taxa are divided into growth form guilds. Species collected only by Cheney (in Thomson 1998) are underlined and those collected in both the historic and modern surveys are bold-faced.

1890's	**Lichen Growth Form Guild/Species**	**Modern Location**							
	Small Foliose:	**P**	**T**	**H**	**A**	**W**	**F**	**C**	**U**
+	***Candelaria concolor* (Dickson) Stein**	+	+	+	+	+	+	+	+
+	*Candelaria fibrosa* (Fr.) Müll. Arg.								
	Hyperphyscia adglutinata (Flörke) H. Mayrh. &	+	+	+		+	+	+	+
	Poelt								
+	***Hyperphyscia syncolla* (Tuck. ex Nyl.) Kalb**	+			+				
	Phaeophyscia adiastola (Essl.) Essl.	+			+		+	+	
+	***Phaeophyscia ciliata* (Hoffm.) Moberg**		+	+	+		+	+	
	Phaeophyscia hirsuta (Mereschk.) Essl.		+					+	
	Phaeophyscia pusilloides (Zahlbr.) Essl.	+	+	+	+		+	+	+
	Phaeophyscia rubropulchra (Degel.) Essl.	+	+	+	+	+	+	+	+
	Physcia adscendens (Fr.) H. Olivier		+	+			+	+	
	Physcia millegrana Degel.	+	+	+	+	+	+	+	+
	Physciella chloantha (Ach.) Essl.	+	+	+	+	+	+	+	+
	Xanthomendoza fallax (Hepp) Søchting, Kärnefelt	+	+	+	+	+	+	+	
	& S. Kondr.								
	Xanthomendoza fulva (Hoffm.) Søchting,	+	+		+	+	+	+	
	Kärnefelt & S. Kondr.								

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+	***Xanthomendoza hasseana* (Räsänen) Søchting,**				+		+	+	
	Kärnefelt & S. Kondr.								
	Xanthomendoza ulophyllodes (Gyelnik) Søchting,		+				+	+	
	Kärnefelt & S. Kondr.								
	Xanthomendoza sp.								+
	Medium-Large Foliose:	**P**	**T**	**H**	**A**	**W**	**F**	**C**	**U**
+	*Anaptychia palmulata* (Michaux) Vainio								
	Flavoparmelia caperata (L.) Hale	+	+	+	+		+	+	
	Flavopunctelia flaventior (Stirton) Hale				+				
	Flavopunctelia soredica (Nyl.) Hale				+		+		
+	*Heterodermia hypoleuca* (Ach.) Trevisan								
	Melanelixia subaurifera (Nyl.) O. Blanco, A.	+							
	Crespo, Divakar, Essl., D. Hawksw. & Lumbsch								
	Myelochroa aurulenta (Tuck.) Elix & Hale	+			+		+	+	
+	*Myelochroa galbina* (Ach.) Elix & Hale								
	Parmelia sulcata Taylor	+	+	+	+		+	+	
	Parmotrema hypotropum (Nyl.) Hale				+		+		
+	***Physcia aipolia* var. *aipolia* (Ehrh. ex Humb.)**	+					+	+	
	Fürnr.								
+	***Physcia stellaris* (L.) Nyl.**	+	+	+	+	+	+	+	
	Physconia leucoleiptes (Tuck.) Essl.	+	+		+		+	+	
	Physconia perisidiosa (Erichsen) Moberg						+		
	Physconia sp.			+					
+	*Platismatia tuckermanii* (Oates) Culb. & C. Culb.								
+	***Punctelia bolliana* (Müll. Arg.) Krog**						+		
	Punctelia rudecta (Ach.) Krog	+	+	+	+		+	+	
+	*Tuckermannopsis ciliaris* (Ach.) Gyelnik								
	Fruticose:	**P**	**T**	**H**	**A**	**W**	**F**	**C**	**U**
+	*Bryoria furcellata* (Fr.) Brodo & D. Hawksw.								
+	***Evernia mesomorpha* Nyl.**				+				
+	***Ramalina americana* Hale**		+		+		+		
+	***Teloschistes chrysophthalmus* (L.) Th. Fr.**						+		
+	*Usnea hirta* (L.) F.H. Wigg.								

P=Picnic Point/Eagle Heights	**T**=Token Creek County Park	**H**=Hiestand City Park
A=UW-Madison Arboretum	**W**=Wirth/Washington City Parks	**F**=Festge County Park
C=Cross Country/Palmer City Parks	**U**=Location in University Heights-Property of UW-Madison	