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Xanthoria parietina in the Inland Pacific Northwest

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Abstract: The lichen *Xanthoria parietina* has a widespread distribution in Asia, Africa, Australia, and Northern Europe. Records of this species in the United States have been limited to coastal areas, hence its common name, “the maritime sunburst lichen” (Brodo et. al., 2007). *Xanthoria parietina* has thus far only been reported once in an inland area in the Pacific Northwest: in Montana (McCune et al., 2014). Here, we report *X. parietina* in additional inland cities in Idaho (Moscow, Coeur d’Alene, and Boise) and Washington (Pullman and Spokane). Our hypothesis that *X. parietina* was introduced to these inland cities on woody plants shipped from coastal nurseries was supported by the following findings: 1) it was found on stock available for sale in an Oregon coastal nursery; 2) in Moscow it was most common in the UI Arboretum in which coastal nursery stock is commonly planted; and 3) it was not found on naturally occurring woody plants in natural areas outside of Moscow. It is important to know where *X. parietina* occurs because it might eventually decrease native lichen diversity through displacement of local species (Gadson et. al., 2010).

Key words: Lichen, First report in Idaho, Nursery stock, *Xanthomendoza*, Diversity, Air quality

Introduction: *Xanthoria parietina* (L.) Th. Fr. is a lichen found primarily on woody plants. In North America it has been reported from coastal areas from Newfoundland to Pennsylvania along the Atlantic coast, and from California to the Pacific Northwest along the Pacific coast (Brodo et al, 2001). It has also been reported from a small part of the Gulf coast in Texas. In *Macrolichens of the Pacific Northwest*, the lichen's range within the region is described as west of the Cascades, from the Willamette Valley to the Puget Trough (McCune and Geiser, 2009). More recently, it has been reported in an inland site in western Montana (McCune et al., 2014), and that stimulated our surveys.

As is typical for lichens, the distribution of *X. parietina* depends on environmental variables such as bark pH, air quality, and distance to a water source. Due to their sensitivity to pollution, lichens are known indicators of air quality. Surveys for *X. parietina* must, of course, distinguish it from similar, yellowish orange lichens on woody plants, and in the inland Pacific Northwest the similar species are *Xanthomendoza hasseana*, *Xanthomendoza fulva*, and *Xanthoria polycarpa*.

Xanthoria parietina is a eutroph which colonizes woody plants in areas with high levels of nitrogen deposition. This lichen is typically found in areas with nitrogen deposition levels between 4.5 and 8 kg/ha/yr, which illustrates its tolerance for nitrogenous pollutants (McCune and Geiser, 2009). In addition, *X. parietina* has been found in areas polluted with 15-30 ppb of sulfur dioxide annually which illustrates its intermediate tolerance to this pollutant (McCune and Geiser, 2009). Both nitrogen and sulfur dioxide are products of industrial and automobile pollution that can accumulate in the environment (Alejo, et. al., 2013). Thus, increasing amounts of air pollution could increase rates of colonization and growth of *X. parietina* in new regions, including inland areas. Some lichens, known as oligotrophs or mesotrophs such as *Alectoria* and

Usnea, exhibit greater sensitivity to pollutants and/or lower growth rates in polluted areas (McCune and Geiser, 2009). Such pollution-sensitive lichens could eventually be displaced by *X. parietina* (McCune and Geiser, 2009; Gadson, et. al., 2010; Silberstein, et. al., 1996; Brodo, et. al., 2007). *Xanthoria parietina* also has a second advantage over pollution-sensitive lichens: a relatively large thallus (to 8-10 cm) with wide (1-7 mm) lobes (Figure 2) (McCune and Geiser, 2009). It seems plausible to hypothesize that a relatively large, pollution-tolerant lichen like *X. parietina* will eventually displace smaller, sensitive competitors on woody plants in more polluted areas like cities (Gadson, et. al., 2010). Recently, *X. parietina* has been monitored in coastal areas by the volunteer activities of people connected with iNaturalist (2009-2015: Alien Lichens of the Pacific Northwest, iNaturalist).

Having confirmed *X. parietina* for the first time in the University of Idaho Arboretum in Moscow, ID, we hypothesized that *X. parietina* was introduced on woody plants purchased from coastal nurseries, and that it would therefore be more abundant in the Arboretum than in natural areas outside Moscow. We thus surveyed woody plant species that were well represented both in the UI Arboretum and also in natural forest on Moscow Mountain, and further surveyed inland Northwest cities other than Moscow, and planting stock in a coastal nursery.

Materials and Methods: During a survey of lichens on woody plants in the University of Idaho Arboretum, *X. parietina* was discovered. Specimens were collected, and sent to Dr. Bruce McCune for confirmation and then deposition in the Oregon State University herbarium. To test the hypothesis that *X. parietina* was introduced on planting stock from coastal nurseries, additional surveys were performed. First, to confirm that coastal nurseries have planting stock that is already colonized by *X. parietina* we inspected stock for sale in a nursery in Sherwood, OR southwest of Portland. Secondly, we

surveyed other inland cities in which coastal nursery stock is commonly planted: Coeur d'Alene ID, Boise ID, Pullman WA, and Spokane WA. Thirdly, we surveyed naturally occurring, woody plants in and around Moscow.

Surveys in and around Moscow were limited to native, angiosperm trees of Idaho, as *X. parietina* is most often found on woody angiosperms and we wanted to analyze the same woody species within the UI Arboretum and in wild stands (McCune and Geiser, 2009). In and around Moscow there were seven sample sites. Three sites had planted trees: East City Park (46° 43' 59.54"N, 116° 59' 24.47"W), Latah County Fairgrounds (46° 43' 26.36"N, 116° 58' 56.55"W), and the UI Arboretum (46° 43' 8.68"N, 117° 0' 58.33"W). Two sites had wild trees: Idler's Rest (46° 48' 1.13"N, 116° 57' 9.92"W) and the South-Side of Moscow Mountain (46° 47' 42.41"N, 116° 52' 33.86"W). At two sites the status of either planted or wild trees was not clear: the edge of an agricultural field near Idler's Rest (46° 47' 14.74"N, 116° 57' 56.32"W) and Heron's Hideout (46° 43' 25.98"N, 116° 58' 43.78"W). Nine species were surveyed for *X. parietina* in the UI Arboretum and at least one other site: *Acer glabrum* Torr., *Alnus tenuifolia* Nutt., *Amelanchier alnifolia* (Nutt.) Nutt. ex M. Roem., *Artemisia tridentata* Nutt., *Crataegus douglasii* Lindl., *Holodiscus discolor* (Pursh) Maxim., *Populus trichocarpa* Torr. & A. Gray, *Prunus virginiana* L., and *Sambucus nigra* L. In the Arboretum there were five individual trees of three additional species: *Populus deltoides* W. Bartram ex Marshall, *Populus tremuloides* Michx., and *Purshia tridentata* (Pursh) DC; these three were not found in the six other sites and were not included in table 1. In all there were 49 and 66 individual woody plants in planted and wild sites, respectively. Surveys were performed by the first author. Each tree was observed for one minute for the presence or absence of *X. parietina* and the three other nitrogenous lichens (*Xanthomendoza fulva* (Hoffm.) Søchting,

Kärnefelt & S. Kondr., *Xanthomendoza hasseana* (Rasanen) Søchting, Kärnefelt & S. Kondratyuk, and *Xanthoria polycarpa* (Hoffm.) Rieber).

Results: *Xanthoria parietina* was found on all 12 woody plant species surveyed in the UI Arboretum. Of the 35 individual Arboretum plants surveyed, 25 were positive for *X. parietina*. In contrast, only one other plant of the other 159 surveyed was positive for *X. parietina* (Table 1). That one was an *Acer glabrum* individual in East City Park. In wild or natural sites outside the city of Moscow, *X. parietina* was not found. The lichen was found in urban areas of the inland Northwest other than Moscow: Coeur d'Alene and Boise (Roger Rosentreter, personal communication), in Idaho; Pullman and Spokane, in Washington. In each of these additional inland cities, the local pattern of distribution was as in Moscow: *X. parietina* was only within city limits and commonly in parks on hardwood ornamental trees that were planted.

In keeping with our hypothesis, *X. parietina* was found on nursery stock near Sherwood, Oregon (Figure 6). The lichen was abundant on larger trees in 3-10 gallon pots. In Moscow, the other three species of yellowish orange, nitrophilous lichens on trees (*X. polycarpa*, *X. fulva*, and *X. hasseana*) were found on trees both inside and outside the city on all nine species that were surveyed both in planted, urban sites and in sites outside the city of Moscow. On trees sampled within the Arboretum, the other orange nitrophiles were found at an incidence of 90%. On trees sampled outside of Moscow, where *X. parietina* was not found at all, the other orange nitrophiles were found at 52% incidence.

Discussion: The findings are consistent with the hypothesis that *X. parietina* can be introduced to inland areas if propagules are transported on nursery stock from its coastal range. The movement of nursery stock was suggested by Brodo and Lindblom (2007, 1997)

as a dispersal method for *X. parietina*. Apart from scattered urban occurrences in inland Idaho, Montana, and eastern Washington, it is clear that *X. parietina* is still primarily coastal within the PNW. In addition to published records, a total of 87 unpublished observations of *X. parietina* (2009-2015: Alien Lichens of the Pacific Northwest, iNaturalist) have confirmed a predominantly coastal distribution. It is likely that *X. parietina* already occurs in other population centers of the inland PNW that we did not survey. More studies are needed to determine where *X. parietina* occurs within the inland PNW, and whether those populations persist in the long term. In coastal areas, *X. parietina* can dominate and displace or exclude other nitrophiles (McCune, 2003). In contrast, on UI Arboretum trees its incidence was typically codominant with other nitrophiles. Figure 1 shows an exception with *X. parietina* by itself on *P. tremuloides*. Dominance by *X. parietina* and displacement of the native species might eventually become commonplace in Moscow, but it is not obvious at the present time. The finding that other nitrophilous lichens decreased in abundance with distance from urban centers and their nitrogen sources was not surprising as that has been researched before (Rogers, et al. 2009; Ra, et al., 2004; Geiser and Neitlich 2006). Competition among nitrophilous tree lichens (Figs. 2-5) might be influenced not only by nitrogen deposition and microclimate but also by direct interaction among competitors (Velthof, et al., 2009).

We do not know when *X. parietina* first appeared in Moscow, but the UI Arboretum began to be developed in the late 1970s. *Xanthoria parietina* was most commonly found on trees planted during the mid-1990s and later, but the lichen was found on older trees as well. It tended to be at a higher density on the younger trees. The lichen has been found on trees planted within the last three years within a park of the Boise River Greenbelt, whereas the lichen is still absent on

the native *P. trichocarpa* near it along the river (Roger Rosentreter, personal communication).

The question of naturalization of *X. parietina* is an important one. At present, there is no evidence for it, as naturalization would only be confirmed by spread of *X. parietina*. Monitoring of the spread of *X. parietina* from planted to local trees is needed since reproduction and spread without human aid is the essence of naturalization. Lichen species diversity in the inland PNW might be at risk if *X. parietina* does eventually naturalize and behave as it is known to do in coastal areas (Brodo, 2007; Gadson, et. al., 2010; Silberstein, et. al., 1996).

Specimen examined - U.S.A., IDAHO. Latah Co., located in the University of Idaho Arboretum and Garden, Moscow; 46°43'01.26" N, 117°00'59.67" W; elev. 2589 ft; habitat is wet, growing near Arboretum drainage, on *Populus tremuloides*, dominant lichen on tree, 14 May 2015, Shannon J. Fraser 7ID (OSC).

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Table 1. Surveys for *Xanthoria parietina* and any one of three similar species (*Xanthomendoza fulva*, *Xanthomendoza hasseana*, and *Xanthoria polycarpa*), were conducted in seven sites in and around Moscow, Idaho. For each tree species, each column shows the total trees present with any of the three similar lichen species (column 1), *X. parietina* (shaded column 2), and the total trees surveyed at each site (column 3). All woody species in the Arboretum and East City Park sites were planted; all those surveyed in the Idler's Rest and South-Side sites were wild.

Planted, wild, or ambiguous trees	Location	<i>Acer glabrum</i>			<i>Alnus tenuifolia</i>			<i>Amelanchier alnifolia</i>			<i>Artemisia tridentata</i>			<i>Crataegus douglasii</i>			<i>Holodiscus discolor</i>			<i>Populus trichocarpa</i>			<i>Prunus virginiana</i>			<i>Sambucus nigra</i>			Totals		
		3	2	5	1	1	1	5	4	5	1	1	1	3	2	4	7	3	7	2	2	2	3	3	3	2	2	2	22	20	30
Planted	Arboretum	3	2	5	1	1	1	5	4	5	1	1	1	3	2	4	7	3	7	2	2	2	3	3	3	2	2	2	22	20	30
Planted	East City Park	4	1	6																									4	1	6
Planted	Latah County Fairgrounds																			8	0	8							8	0	8
Wild	Idlers Rest	6	0	14				3	0	3				0	0	2	0	0	8				6	0	7				15	0	34
Wild	South side Moscow Mtn				7	0	10	5	0	7	2	0	6				0	0	4							5	0	5	19	0	32
Ambiguous	Agricultural field near Idlers Rest													0	0	5				6	0	6							6	0	11
Ambiguous	Heron's Hideout				5	0	6	5	0	5				6	0	6	4	0	4	10	0	12							30	0	33
Totals		13	3	25	13	1	17	18	4	20	3	1	7	9	2	17	11	3	23	26	2	28	9	3	10	7	2	7	104	21	154



Figure 1. *Xanthoria parietina* (e.g. circled in red) dominating the lichen community on *P. tremuloides* near a drainage ditch at the Arboretum.



Figure 2. Thalli of *X. parietina* collected in the University of Idaho Arboretum, Moscow, Idaho.



Figure 3. Thalli of *Xanthomendoza hasseana* collected in the University of Idaho Arboretum, Moscow, Idaho.



Figure 4. Thalli of *Xanthomendoza fulva* collected in the University of Idaho Arboretum, Moscow, Idaho.



Figure 5. Thalli of *Xanthoria polycarpa* collected in a riparian area on the edge of Moscow, Idaho.



Figure 6. *Xanthoria parietina* on a potted *Styrax japonicus* Siebold & Zucc. in a tree nursery near Sherwood, Oregon.