"LICHENS LITE?" CHEMICAL ANALYSIS OF LICHENS FOR TRACKING 26 POLLUTANTS

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Abstract—Lichen chemistry can be used to estimate concentrations of environmental contaminants, ranging from heavy metals and fertilizers to polycyclic aromatic hydrocarbons, dioxins, pesticides, herbicides, and flame retardants. We conducted a pilot looking at 26 metals and nutrient anions in 5 widespread lichen species across the upper Midwest, including: As, Al, Ba, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, N, Na, Ni, P, Pb, S, Se, Si, Sr, and Zn. FIA crews collected 135 lichen samples from 75 plots across IL, IN, IA, MI, MN, WI and an expert collected 128 additional samples near 11 air monitors. Elements were measured in lichens using C, N, S, and Hg combustion analyzers and ICP-AES. Crews trained for 6 hours. Field time required per lichen sample ranged from 0.5 to 2 hrs, depending on target species. Contractors prepped samples for chemical analysis for an average of 30 to 45 minutes. The small but widespread species, *Physcia aipolia/stellaris*, took 1.5 hr/sample. Lichen concentrations of only 6 elements were below the detection limit or considered too variable to be of use (CV > 25%; Mo, B, Ba, Si, As, Se). No lichen species is found everywhere and species may accumulate pollutants at different rates. We used regression or univariate GLM between some species pairs to create conversion factors for some elements. Compared to the Phase3 Lichen Communities Indicator (LCI), advantages of chemical analysis are lower costs, less field time, and ability to map a broader range of pollutants. However, a key benefit of LCI is that it quantifies species gains and losses, which is an ecosystem response to air quality. Chemical content of lichens is not ecologically meaningful on its own, serving more as a mapping tool. Nonetheless, critical loads (pollutant thresholds known to be associated with ecosystem responses) may be used as reference points in lichen maps.

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