## Multivariate Receptor Modeling with Widely Dispersed Lichens as Bioindicators of Air Quality

Lichens are frequently used as air-quality bioindicators. While biomonitoring studies evaluating airborne element accumulation patterns in lichens relative to specific pollution sources are common, most control variability by focusing on narrow geographic regions and collections made over short time windows. Here, we investigate to what degree accumulation patterns of generic pollution sources are detectable on broad geographic and temporal scales. Using samples of the widespread “rock-posy" lichen sampled across the Intermountain Region of the USA, we contrast analyses of elemental concentrations employing positive matrix factorization (PMF) and Bayesian multivariate receptor models (BMRM). We extend the standard Bayesian implementation to include i) separately estimated lichen secondary chemistry as a factor and ii) shrinkage priors to allow for sharper selection among a set of candidate sources at each site. Through regularization, the extended model is better able to maintain source identity, as specified though informative prior distributions on elemental profiles. Quantitative profile matching shows that the PMF model primarily captures variations of the baseline profile. Both PMF and BMRM results suggest that the most detectable signatures relate to aeolian dust deposition, while spatial patterns hint at anthropogenic signatures near industrial activity and population centers.