



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Adam Esch; Grace Millikin	Project Number J0907
Project Title Lichen Diversity: An Environment Indicator of Air Quality	
<p style="text-align: center;">Abstract</p> <p>Objectives Lichen is a symbiosis between fungi, yeast, algae and/or cyanobacteria. We learned about lichens sensitivity to air pollution, especially particulates PM(2.5) and PM(10), and wondered whether its presence might be an indicator of air quality. We hypothesized that a site with particulate levels of PM(2.5) and PM(10) above 35.5 micrograms/m³ would exhibit lower lichen diversity than a site with levels below 35.5 micrograms/m³.</p> <p>Methods To test our hypothesis, we chose two locations in Southern California: a site in Carlsbad, with particulate levels that were historically below 35.5 micrograms/m³, and a site in El Cajon, with air quality historically above 35.5 micrograms/m³. We visited both sites multiple times over several weeks and spent many hours locating and photographing lichen species at each site. Using a particulate meter, anemometer, hygrometer and probe thermometer, we measured and recorded levels of PM(2.5) and PM(10), wind speed, humidity, and temperatures of the air, soil, and lichen substrates. We identified, documented and correlated the number of lichen species to the air quality at each site.</p> <p>Results Overall, we documented 12 lichen species at the Carlsbad site, where levels of PM(2.5) averaged 31 micrograms/m³ during our testing, according to the San Diego Air Pollution Control District (SDAPCD). SDAPCD PM(10) measurements were not available for this site. We documented 8 lichen species at the El Cajon site, where levels of PM(10) reported by SDAPCD averaged 42 micrograms/m³ and PM(2.5) averaged 38 micrograms/m³. Our particulate measurements differed from SDAPCD data, possibly because our instrument had a relative accuracy of plus or minus 15 micrograms/m³. Of the 20 species we found, we identified three species in common at both sites: Xanthoria elegans, Acarospora socialis, and Xanthoparmelia cumberlandia.</p> <p>Conclusions As hypothesized, the test site with average particulate levels below 35.5 micrograms/m³ exhibited significantly greater lichen species diversity than the site with particulate levels above 35.5 micrograms/m³. Although we identified 33 percent more species in Carlsbad, which had significantly better air quality, other factors may contribute to this outcome, such as year round humidity levels. If we were to repeat this project, we would use a more accurate particulate meter. We would also expand our criteria to other pollutants including ozone, sulfur dioxide, and metals such as copper.</p>	
Summary Statement This project investigates the correlation of lichen species diversity to ambient levels of particulates PM(2.5) and PM(10) at two sites in Southern California.	
Help Received After we identified some of the lichen species that we documented, we visited Julia Adams, Mitch Provence, and Andrew Sanders at UC Riverside to confirm identifications. We also visited the San Diego Air Pollution Control District website for historic pollution averages.	