In the Midwestern U.S., where almost all native grassland has been lost to agriculture and development, many groups work to restore native prairie. One reason to restore these grasslands is for their soil carbon sequestration potential compared with row crops and old fields (former agricultural sites now dominated by woody and non-native species). When looking at an old field and prairie side by side, SSSA member Louise Egerton-Warburton, a conservation scientist at the Chicago Botanic Garden, says the usual assumption is that “the disturbed site or old field site would have poor levels of carbon sequestration, whereas a beautifully restored prairie or a native prairie is expected to have very high potential for carbon sequestration.”

Research from the Midwest has shown that when agricultural fields are restored to prairie, there is an increase in soil carbon proportional to the increase in time since restoration.\(^1\) Egerton-Warburton and her colleagues were curious to see if the same pattern would hold true for restorations occurring in an urban matrix. She says that these sites may respond differently as they are “exposed to pollution that they were never exposed to before, especially nitrogen deposition, and also just a general increase in human traffic through the area where people walk and exercise their dogs.”

In a recent article published in the *Soil Science Society of America Journal* (SSSAJ), the researchers report on a study in which they collected samples from 14 sites in the greater Chicago area in 2012 and compared old fields, short-term (one to seven years) and long-term (10+ years) prairie restorations, and remnant native prairie sites.

Egerton-Warburton praised the hard work of co-author, Jenifer Yost, in processing the samples to measure aggregate size, total soil organic carbon (SOC), and other data included in the analyses. Yost worked on this project for her undergraduate thesis, and Egerton-Warburton says, “[Jenifer] did a wonderful piece of work. It was largely due to her diligence and

persistence that we got to the end of the analyses.”

Unexpected Results

When analyzing the data, the team was initially surprised by the results. Contradictory to their hypothesis, the old field sites had greater SOC than both short- and long-term restoration sites. They also did not see the expected proportional increase in SOC with increasing time since restoration. Using multivariate techniques, including principal component analysis (PCA) and path analysis, Egerton-Warburton and co-authors found that the SOC, microaggregate levels, and macroaggregate levels observed in long-term restorations were more similar to old fields than short-term restorations or prairie sites.

Given that old fields are being restored to prairie, Egerton-Warburton says it is important to recognize “that old fields actually have a large store of carbon to begin with” and that the process of restoring these sites—clearing vegetation, removing drain tile, using heavy equipment, seeding and replanting vegetation—disturbs the soil and can release SOC.

In addition to total SOC and aggregate analysis, the researchers examined the SOC inputs of C3 and C4 grasses. Restorations typically reduce C3 grasses and increase C4 grasses, and these two functional groups have different SOC inputs. When evaluating the contribution of SOC from C3 and C4 plants, the team did find the expected shift from C3 contribution in old field sites to C4 in restorations. However, the long-term restorations did not show greater C4 SOC contributions than the short-term sites.

The authors suggest that their findings could be explained by a reduction in belowground productivity or changes in the nutrient cycling compared with native prairie sites. Or, Egerton-Warburton points out, “Differences between short- and longer-term restorations, in our study, might also reflect the fact that restoration practices have really come a long way in, say, the last 10, 15 years.”

Bringing these belowground dynamics to the attention of restoration practitioners is important as restorations are often assessed and monitored using aboveground metrics like plant diversity. “Our study indicates that metrics of belowground functioning provide important insights into the efficacy of the restoration process and that beauty aboveground does not necessarily correlate with a functional soil ecosystem,” Egerton-Warburton says.

Although the results were unexpected, Egerton-Warburton does not see the study discouraging efforts to restore prairie in the Chicago area. “I think it still is worth undertaking these restorations because you’re increasing soil quality in many different ways. You’re returning native plant growth into the soil, and you have roots that are stabilizing the soil so you decrease the potential for erosion.” There are also the benefits of restoring habitat for rare plants, insects, grassland birds, and other wildlife in an urban area.

This study was the first time Egerton-Warburton sampled these urban sites, but there is potential for future research projects. “We’re going forward with more work on the fungal and bacterial communities to see how abundant they are, what’s in the community itself, and how that would relate to the carbon sequestration potential.”