

ABSTRACT

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Effects of land cover, land-use history, and within-land cover variability on soil-based ecosystem services in urban Madison, WI

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Urban ecosystems are increasingly recognized as providing important ecosystem services (ES). However, most urban ES studies measure only a single service, and often ignore the spatial heterogeneity and land-use history of cities. We measured soil properties and nutrient pools indicative of 3 services (carbon storage, water quality regulation, and runoff regulation) in 100 sites across Madison, WI. Sites encompassed 5 land-cover classes and spanned a ~125 year historical gradient, representing transition from agricultural to urban use. We asked: what are the relative effects of current land cover, within-land-cover variability, and land-use history on ES provision? Preliminary results indicate semi-natural sites stored less C (6.4, 6.8 kg/m² in grasslands, forests, to 25 cm depth) than developed (8.0, 9.2, 9.3 kg/m² for low density, medium density, open space). Available P was lowest in grassland and open space (39 ppm), followed by forests (50 ppm), and low- and medium-density developed sites (59, 62 ppm). Thus, semi-natural cover supports higher water quality regulation services (lower P), while developed sites had the highest carbon storage. However, land-cover proxies alone had limited explanatory power. In developed sites, C increased with time since development at depths >5 cm (32-44% over 100 years), suggesting consistent accrual of C following conversion from agriculture. Surprisingly, P also increased with time since development (25-70% over 100 years), suggesting factors other than agricultural legacies control soil P. Soil-based urban ES depend on past and current land use, and the role of history should be considered to better understand urban ES provision.