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Experimental Order 1 soil survey of vacant urban land, Detroit, Michigan, USA

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ABSTRACT

An Order 1 soil survey was made of a vacant lot < 0.1 ha in size using a square grid with a two meter spacing (n = 90 points) to test the hypothesis that there is a mappable pattern of anthropogenic polypedons against the alternative that the distribution is random. The vacant lot was formed circa 1998 by demolition of a wood-frame home from the 1920s in an urban residential setting in Detroit, Michigan. The anthropogenic soils studied were formed on a 0–2% slope under grass vegetation from artificial fill comprised of a mixture of poorly drained native soil materials, glacial sediments and artifacts (objects of anthropogenic origin), mainly waste building materials. The results suggest that anthropogenic soils on vacant urban land are mappable, even at the scale of a single vacant lot. The soils approximated an anthrosequence, i.e. a genetically related group of profiles whose characteristics differ mainly as a result of anthropogenic activity. The anthrosequence is comprised of soil phases whose range of characteristics can be used to define anthropogenic taxa, or to characterize the map unit composition of native soil–urban land complexes found on vacant property produced by building demolition. The results also suggest that, in the absence of historic records, demolition site history can be reconstructed from the spatial distribution of artifacts and soil types. More Order 1 surveys are needed to define the characteristics of anthrosequences in other urban settings and involving different soil orders, and to develop predictive urban soil–landscape models needed to provide better interpretive information for users of urban soil survey maps.

1. Introduction

The societal need for urban soil mapping has been increasing in importance not only because population is growing exponentially, but because the proportion of people living in urban areas has grown (Bernknopf et al., 1996). For example, the amount of urban land in the United States quadrupled from 1945 to 2002, increasing at twice the rate of population growth (Lubowski et al., 2006). The percentage of U.S. population living in cities has grown from 70% in 1964, to 82.3% in 2010, and consequently urban land currently comprises ~2.6% of the U.S. (Hooke et al., 2012). Although the importance of urban soil interpretation has been recognized for many years (Miller, 1978), anthropogenic soils were delineated simply as urban- or made-land on most soil survey maps. Efforts to classify (Soil Survey Staff, 2014) and map (e.g., New York City Soil Survey Staff, 2005; Calsyn et al., 2011) anthropogenic soils have only recently begun to materialize. On newer soil survey maps, urban land is delineated as native soil series–urban land complexes, the compositions of which remain poorly defined. Thus, further study is needed via Order 1 and 2 surveys to obtain better interpretive information for users of urban soil maps. There is a pressing need for soil maps in many urban areas because building demolition has produced large tracts of vacant land. This open space has attracted considerable interest as a natural resource for urban agriculture, green infrastructure, etc. (Shuster et al., 2011, 2014). However, demolition site soils are usually in need of revitalization because of excessive compaction, low organic matter content, contamination, and an overabundance of artifacts (USEPA, 2011).

The purpose of this study was to assess the mappability of demolition site soils in a typical urban landscape. An Order 1 soil survey (scale = 1:200) was carried out to test the hypothesis that there is a mappable pattern of anthropogenic soils against the alternative that their areal distribution is random. Three vacant lots, each formed by demolition of a single family home in Detroit, Michigan, USA, were mapped using a grid comprised of closely spaced sampling points. One lot, not discussed further here, was found to have few artifacts and a relatively simple pattern of anthropogenic soils. A second lot from the 19th century with soils containing abundant artifacts of archeological significance is described in a separate paper (Howard et al., 2015). The site described here contained abundant artifacts, a complex pattern of soils, and had supplemental subsurface data obtained with a Geoprobe. Additional data were also collected from soil borings around numerous abandoned, derelict buildings in the city. The results are used to

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formulate a predictive urban soil–landscape model to facilitate mapping of vacant urban land.

2. Materials and methods

2.1. Study area

The study site is located in the Highland Park 7.5 min topographic quadrangle which encompasses part of the city of Detroit in southeastern Michigan (Fig. 1A). Detroit is located along the Detroit River adjacent to Windsor, Ontario, Canada. The city lies on a nearly level plain (Detroit lowland) formed by a series of glacial paleolakes during the Port Huron phase of late Wisconsinan time about 12,400 yr BP. The Detroit lowland is underlain by a relatively thin (<6 m thick) glaciolacustrine deposit comprised of weakly stratified clayey diamicton overlain by a discontinuous capping of sand usually <1 m thick (Howard, 2010). The site studied is located along the trend of the paleoshoreline of glacial Lake Grassmere (Sherzer, 1916) at an elevation of 190 m. Detroit has a humid-temperate (mesic) climate, a mean annual temperature of 9 °C (49 °F), 99 cm yr^{-1} of precipitation, and a frost line at 107 cm depth. Native soils that are widespread on the poorly drained lakebed plains beneath Detroit are generally Ochraqualfs and Argiaquolls (Larson, 1977).

The site studied is a vacant lot, approximately 288 m^2 (0.024 ha; 0.06 ac) in size, located at 8336 Wisner St. (N42°24.794′ and W083°01.065′) adjacent to Coleman A. Young Airport (Fig. 1B and C). Sanborn maps show that the area was still farmland in 1915. The Baist Real Estate Atlas of 1929 and Polk Directory show that a house was built on the lot and first occupied in 1925. No records were available from the city, but aerial photographs indicate that it was demolished between 1994 and 1998. A derelict, abandoned house is present on the adjacent lot to west, which may be of similar construction to the one demolished. The lot to the east is vacant, and contains a small patch of wetland. The lot studied is overgrown in grass and weeds. Piles of demolition debris in back of the lot are overgrown in trees (Fig. 1C). The lot studied is part of a large 50 ha tract of vacant land created as part of a failed plan of airport expansion, according to

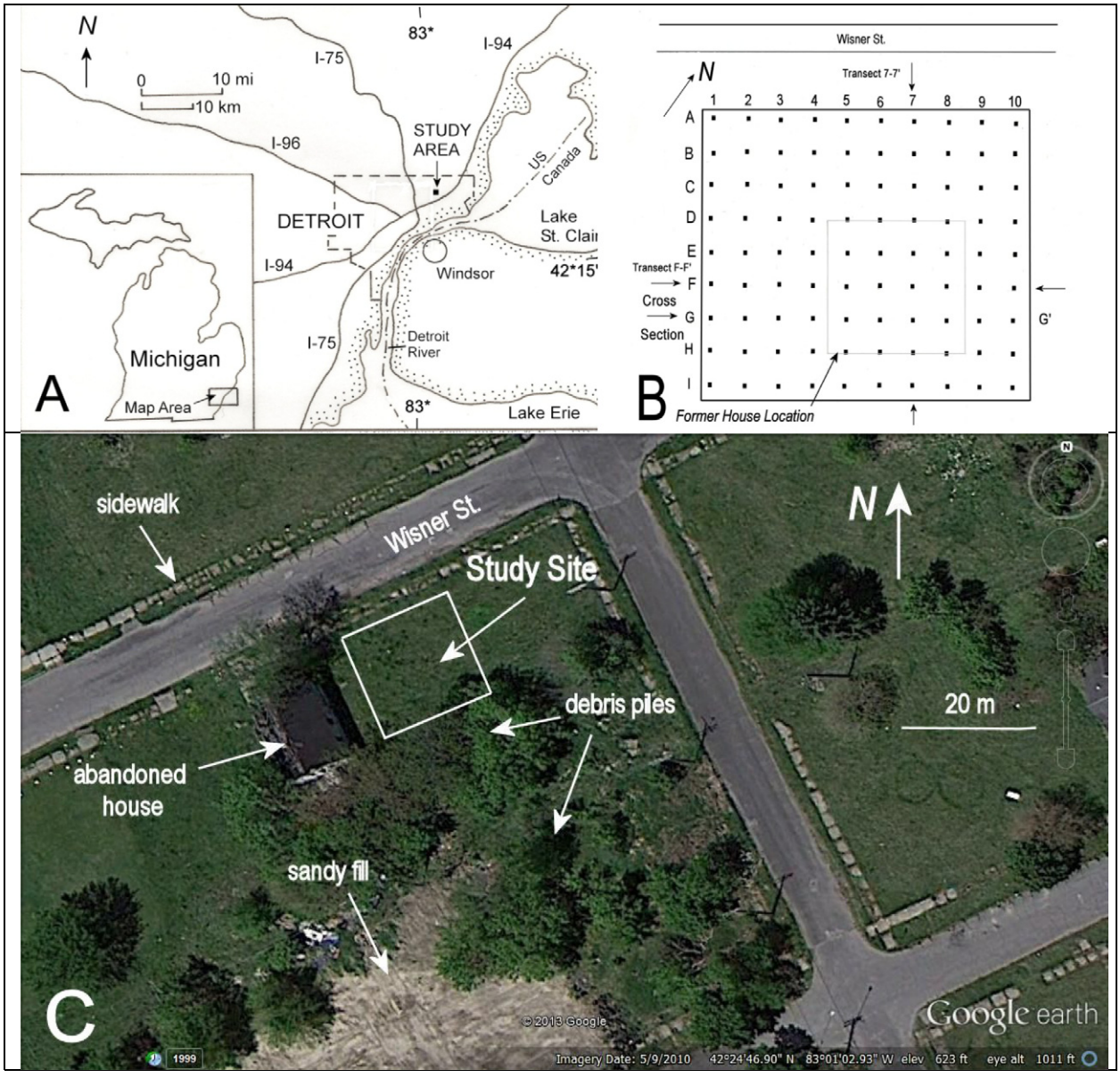

Fig. 1. Location maps: A, Location of Detroit City and the area studied in southeastern Michigan; B, Configuration of the sampling grid showing locations of transects; C, Layout of the vacant lot studied.