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USA Appalachian relict charcoal hearths have complex landscape and pedologic patterns that are unique from surrounding forest ecosystems

Patrick Drohan[1], Samuel Bayuzick[1], Daniel Guarin[1], Thomas Raab[2], Alexander Bonhage[2], Duane Diefenbach[1,3], and Marc McDill[1]

[1]The Pennsylvania State University, Ecosystem Science & Management, University Park, United States of America
[2]Institut für Umweltwissenschaften, Brandenburgische Technische Universität Cottbus-Senftenberg, Germany
[3]U.S. Geological Survey, Pennsylvania Cooperative Fish & Wildlife Research Unit, University Park, United States of America

Understanding how present-day abrupt change may alter forest ecosystem services is becoming more important due to ever-growing anthropogenic stresses. Forest managers trying the adapt to anthropogenic stress can benefit from the study and quantification of past abrupt changes in forests, especially when the legacy of past disturbance is still evident. Across the United Kingdom, Europe, and recently the northeastern United States, the examination of historic forest change due to charcoal manufacturing for the firing of iron or lime furnaces is yielding new insights relative to landscape stability, anthropogenic vs natural soil genesis, and forest evolution.

A landscape classification process was used in the Central Appalachians (Pennsylvania) to identify 6,758 RCHs near Greenwood Furnace (Greenwood Furnace State Park) and Pine Grove Furnace (Pine Grove Furnace State Park). Topographic wetness index (TWI), and SAGA wetness index (SWI) were created using ~1m LiDAR data for two study areas to quantify surface hydrology effects and were compared to field soil volumetric water content (VWC) measurements. Modeled TWI and SWI values were different for RCH areas when compared to surrounding non-hearth areas indicating that RCHs were acting as a moisture sink. We also found that RCH platforms have different TWI and SWI values than rim areas. Using field measured volumetric water content, we found that as distance from the center of the RCH increases, the drier the soil becomes. Geomorphic position did not affect wetness.

Surface soil samples were collected at 51 RCHs in the Greenwood Furnace study area. Laboratory analyses revealed that RCH soils have higher C content than surrounding native soils. Furthermore, while the pH of RCH soils is like native soils, the acidity is greater in RCHs. RCH soils at Greenwood Furnace were found to have lower Mehlich 3 P concentrations and lower K potentially effecting plant growth. RCH soils were found to have higher Ca concentration when compared to native soils.

To examine within RCH differences in soil chemistry and morphology more closely, 8 of the 51 RCHs were sampled intensely along a topographic gradient. Control pits were excavated directly

upslope from the RCHs. The RCHs were sampled in 5 positions across the hearth from the upslope to down slope position (A upslope rim of the RCH; B halfway point between A and C; C RCH center; D halfway C and E; E downslope rim of the RCH). Soil profiles were described and sampled at each position. The soil samples were analyzed for trace and rare earth element content (Aqua Regia digestion), soil pH (water) and fertility (Mehlich 3 extraction). Results indicated that RCHs are potentially a unique location of refugia for forest flora and perhaps fauna due to the unique geochemistry with higher bases and C and some concentrated metals and a higher soil water content hypothesized to be due to an observed restrictive morphology. Future research should more closely investigate whether RCHs support unique species assemblages and how they may play a role in enhancing today's forest biodiversity.