Broadleaf and conifers and their interaction with soil biota play contrasting role in soil C sequestration at various stages of pedogenesis

Lucie Hüblová1, Saliha Irsah1, Jan Frouz1,2

1- Charles University, Faculty of Science, Institute for Environmental Studies, Benátská 2, 12800, Praha 2, Czech Republic
2- Biology Centre CAS, Institute of soil biology and biogeochemistry Na Sádkách 7, České Budějovice, Czech Republic

Soil has contains three times more C than the atmosphere and biosphere combined. and play an important role in the carbon (C) cycle.
Soil organic mater (SOM) cam be roughly divided into two pools. The first pool is referred as free particulate organic matter (FPOM), the other pool is comprised of microbial necromass, associated with soil mineral matrix, so called mineral associated organic matter (MAOM). It is assumed that MAOM becomes C saturated during soil development because it is limited by the amount of available mineral surfaces. FPOM, on the other hand, does not saturate and can therefore play an important role in later stages of soil development. Supplying easily decomposable litter may support buildup of MAOM when soil is not C saturated. Earlier studies show that in soil in early stages of decomposition more C is stored in soils supplied by easily decomposable litter (namely broadleaf litter with low CN ratio) while in mature soils conifers producing les decomposable litter with high CN ratio stores more C.
We tested hypothesis that MAOM is supported by providing litter with low CN ratio in early stages of pedogenesis while C storage in POM and forest floor is supported by litter with have propose that earthworm bioturbation may support C storage in unsaturated soils only. To do so we analyze forest floor and C storage in soil and amount of C in FPOM and MAOM using two types of soils - spoil heap (immature soil in early stages of pedogenesis) and forest soil in the surrounding area (mature soil). Replicated plots with only one type of tree species (spruce or alder) in 3 replications were present on each of these soil types. Our results show that different tree species have different effects on the amount of C stored in mineral soil and forest floor (Oe layer) in immature and mature soils. In mineral soil more, C was sequestered under alder on immature soil, while in the mature soil more C was sequestered under spruce. In forest floor more, C was sequestered under spruce in both types of soils. Soils did not differ in the amounts of FPOM and MAOM present in soil, but they did differ in the amount of C stored in these fractions. MAOM stored significantly more C in Immature soils than in forest soil but for FPOM no difference was observed between the two types of soils. Separate manipulation experiments show that earthworm bioturbation may support C storage in soils which are not C saturated.

Using FALCON an array of artificial catchments to study the role of surface heterogeneity on erosion and other ecosystem procese in early stages of ecosystem development

Frouz J.[1,2], Oppong J.C[1,], Bartuška M. [1,2], Kukla J.1, Houška J. [14]Frouzova J. [1,2], Vindušková O.[1]
1 Charles university in Prague, Benátská 2, Praha 2, Czech Republic
2 Biology Centre, Na Sádkách 7, České Budějovice, Czech Republic
3 Czech technical university in Prague, Thakurova 7, Praha 6 , Czech Republic

4 Brandenburg Technical University Cottbus – Senftenberg, Konrad-Wachsmann-Allee 6, Cottbus, Germany
5 The Silva Tarouca Research Institute for Landscape and Ornamental Gardening, Lidická 25/27, Brno, Czech Republic
This study combines results from a series of artificial catchments FALCON and two chronosequences of rehabilitated and unrehabilitated post-mining landscapes near Sokolov (Czech Republic). All study sites were formed by the deposition of post-mining overburden consisting of Miocene clays impregnated with carbonates and fossil organic matter (kerogen). Each chronosequence consists of four sites and covers the first 65 years of ecosystem development. FALCON was established in 2019 and allows the first stages of ecosystem development to be studied in detail. It consists of four parallel catchments (0.25 ha each) that are completely isolated hydrologically. Two catchments are rehabilitated and two are not, as is common in the region, copying the approaches used at the sites of the rehabilitated and unrehabilitated chronosequences. The remediated areas were leveled and planted with alders, while no action was taken in the non-remediated areas where the longitudinal undulations created by the fill remain. In the remediated areas, alders formed a closed canopy in the 10-15 year old areas. In unrehabilitated areas, sheath willow, birch, and aspen are the predominant trees colonizing the areas and forming a closed canopy in the 15-25 year old areas.
Detailed surface change studies using erosion pins and 3D terrain models created using drones show that the surface area in the undulating areas is decreasing more than in the apartment areas, while sediment loss measurements show no difference between the apartment and undulating areas. In wavy areas, there is a great heterogeneity in the erosion process. The upper part of the undulations is heavily eroded, while the eroded material accumulates in the depression. The depressions contain more silt and clay material, have higher water retention and lower infiltration rates, while the opposite is true for the elevated wave tops. Studies along the chronosequence also show that the elevated portion of the waves retain portions of the original mudstone that are more resistant to weathering, such as pelocarbonates. These stone-like parts of the mudstone provide the safe spaces for woody vegetation to colonize. In contrast, the vegetation in the depressions between the waves is dominated by grasses. The study shows that vegetation establishment depends on the formation of microsites with specific soil conditions created by surface processes in the initial phase of ecosystem development. Surface heterogeneity affect also proportion of surface and subsurface runoff and quality of run off water.