Decoupled wild boar impacts on biogeochemical cycles and soil microbiome: perspectives for management oriented to either climate change mitigation or biodiversity conservation

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In the framework of climate change mitigation, the effect of wild fauna on soil C storage has been previously investigated, with different outcomes from different ecosystem types. Wild boars in particular, can limit soil sink capability through grubbing, enhancing porosity and oxygenation and thus SOM decomposition, while trampling, by soil compaction, can negatively affect SOM decay.

Here, we assessed wild boar impact on topsoil properties, including soil C and N stocks and C quality as assessed by ^{13}C CPMAS NMR, with paired undisturbed and disturbed plots across open and close canopy cover in temperate mixed deciduous forest in NE Italy. We also addressed the associated changes in soil microbiome, considering taxonomic and functional diversity, assessed from 16S and ITS eDNA metabarcoding and taxa annotation available from on-line databases of public domain, respectively.
We found a distinct physicochemical signature in disturbed vs. undisturbed soils, with higher bulk density and lower organic C and N content in both canopy conditions. ^{13}C NMR spectra showed an increase in aliphatic and aromatic C and a decrease in labile carbohydrates, limited to disturbed sites with closed canopy, suggesting different net effects in different vegetation conditions emerging from differences in microbial SOM processing. Correspondingly, taxonomic and functional diversity, and their compositional components, significantly differed among canopy and disturbance conditions. The differential effect of wild boar between closed and open canopy, respectively related to the predominance of grubbing and trampling, emerged as a significant decrease of soil C and N stocks only in close canopy conditions, highlighting that the role of wild boar, even on a subnational spatial scale, is largely context-dependent.

Finally, as the effects of wild boars on climate mitigation potential and biodiversity of the forest soil were decoupled, our study open interesting perspectives for application, with alternative management options oriented to different objectives.