

Post-Disturbance Soil Functioning:

Carbon Sequestration and Nutrient Cycling After Windstorm Vaia

Francesca Vannucchi^{1,2*}, Roberto Pini¹, Silvia Traversari^{1,2}, Marco Carlo Mascherpa¹, Tommaso Sitzia^{2,3}, Ernesto Renato Bovio³, Alessio Giovannelli^{4,2}, Emanuele Lingua³, Davide Marangon³, Marco Pellegrini⁵, Andrea Scartazza^{1,2}, Carlo Calfapietra⁶, Giovanni Trentanovi⁴

¹Research Institute on Terrestrial Ecosystems (IRET), National Research Council of Italy (CNR), Via Moruzzi 1, 56124 Pisa, Italy; ²National Biodiversity Future Center (NBFC), Palermo 90133, Italy; ³Department of Land, Environment, Agriculture and Forestry (TESAF), UNIPD; ⁴Research Institute on Terrestrial Ecosystems (IRET), National Research Council of Italy (CNR), Via Madonna del Piano 10, 50019 Sesto Fiorentino (FI), Italy; ⁵Studio forestale Pellegrini, Asiago, Italy; ⁶Research Institute on Terrestrial Ecosystems (IRET), National Research Council of Italy (CNR), Via Marconi 2, 05010 Porano (TR), Italy

*email: francesca.vannucchi@cnr.it

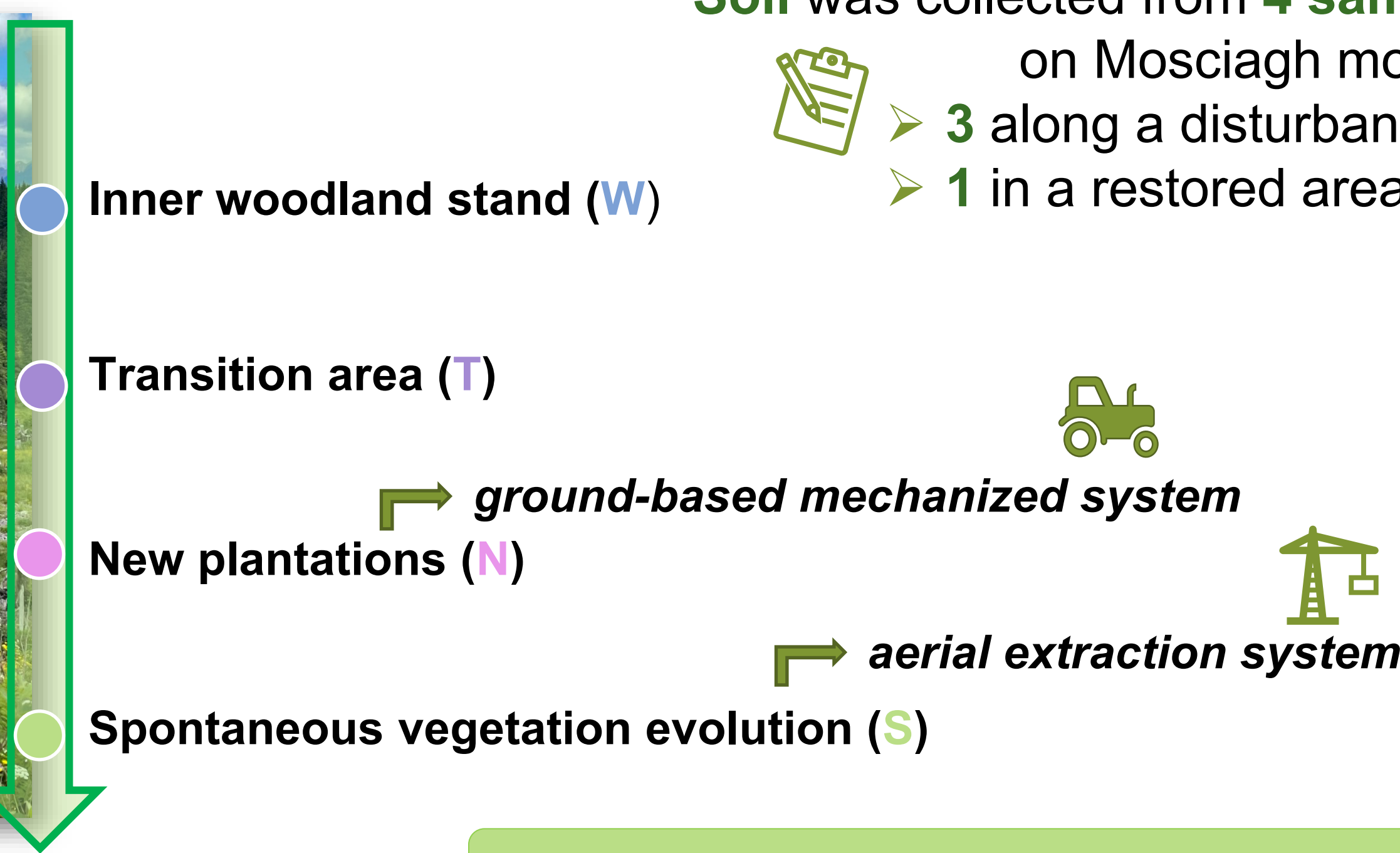
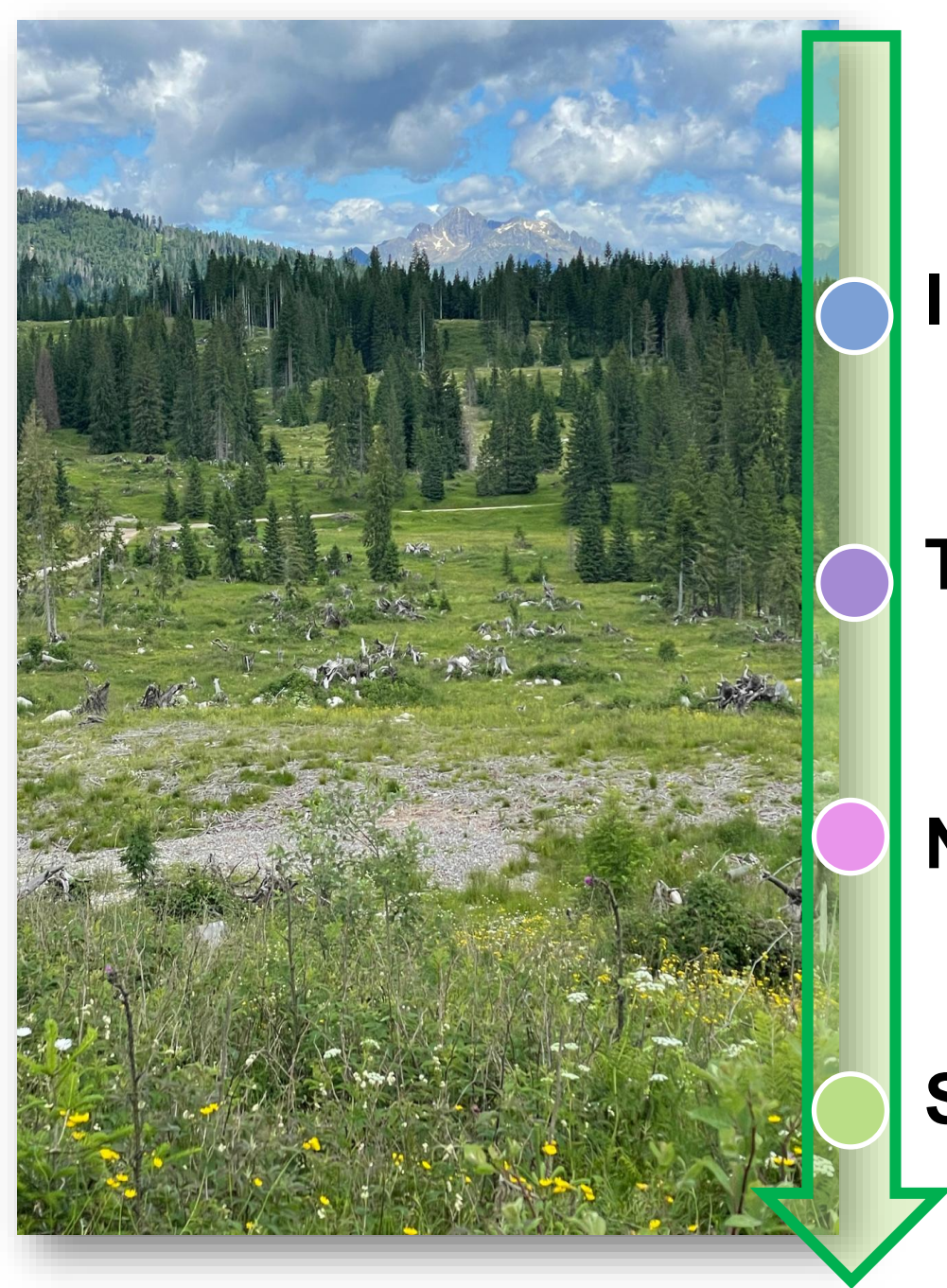
Introduction



Climate change has increased the frequency of extreme events with high environmental, social and economic impacts. In 2018 the windstorm VAIA hit north-eastern Italy, affecting about 45 kha of forests. The windthrow and the following salvage logging may have negatively affected the soil functionality.

Aims of the study were to assess the effect of wind disturbance and salvage logging practices on the soil health and the efficiency of natural regeneration as restoration strategy, with a focus on carbon and nutrient cycling and soil carbon sequestration.

Study area and data collection



Results & Discussion

Were carbon and nutrient availabilities limiting factors ?



Enzyme activities and stoichiometry are tools to detect alteration in nutrient and carbon availabilities.

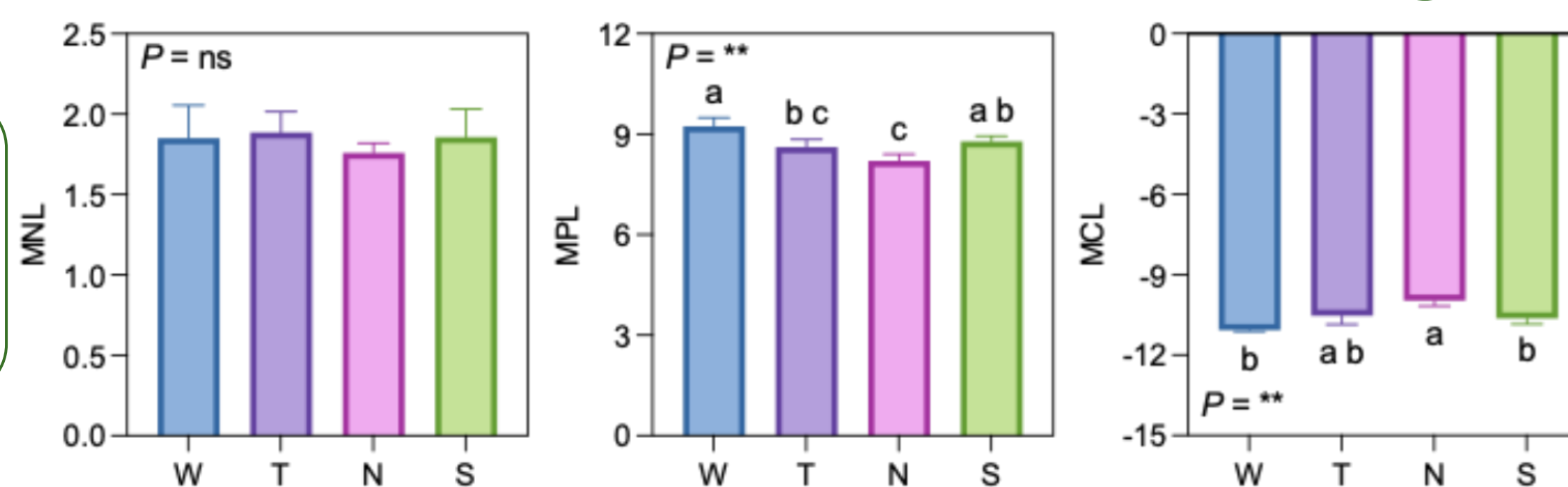


Figure 1. Microbial nitrogen (MNL), phosphorus (MPL) and carbon (MCL) limitations (unitless). Lowercase letters highlight significant differences ($P < 0.05$) among sampling areas according to one-way ANOVA and Tukey's post hoc test.

All areas showed microbial N and P limitations (MNL, MPL > 0), while microbial C was not limiting (MCL < 0) (Fig. 1). However, significant differences among in MPL and MCL were observed amongst areas, with N showing lower P limitation and a tendency toward C limitation compared to W. In contrast, S did not differ significantly from W in terms of MPL and MCL. These patterns may be linked to an increased rate of organic matter degradation in N, which likely enhanced P while reducing C availabilities. This process may have been worsened by physical disturbance from ground-based mechanized salvage logging and the limited litter input.

Did the amount of mineral-associated organic matter change ?

The soil organic matter, associated to minerals, was significantly lower in N than in other areas (Fig. 2). The physical disturbance, derived by ground-based mechanized salvage logging, probably broke down soil aggregates, exposing the organic C to decomposition.

SOM fractionation allows to quantify the persistent fraction of organic carbon, i.e., the portion associated with soil minerals

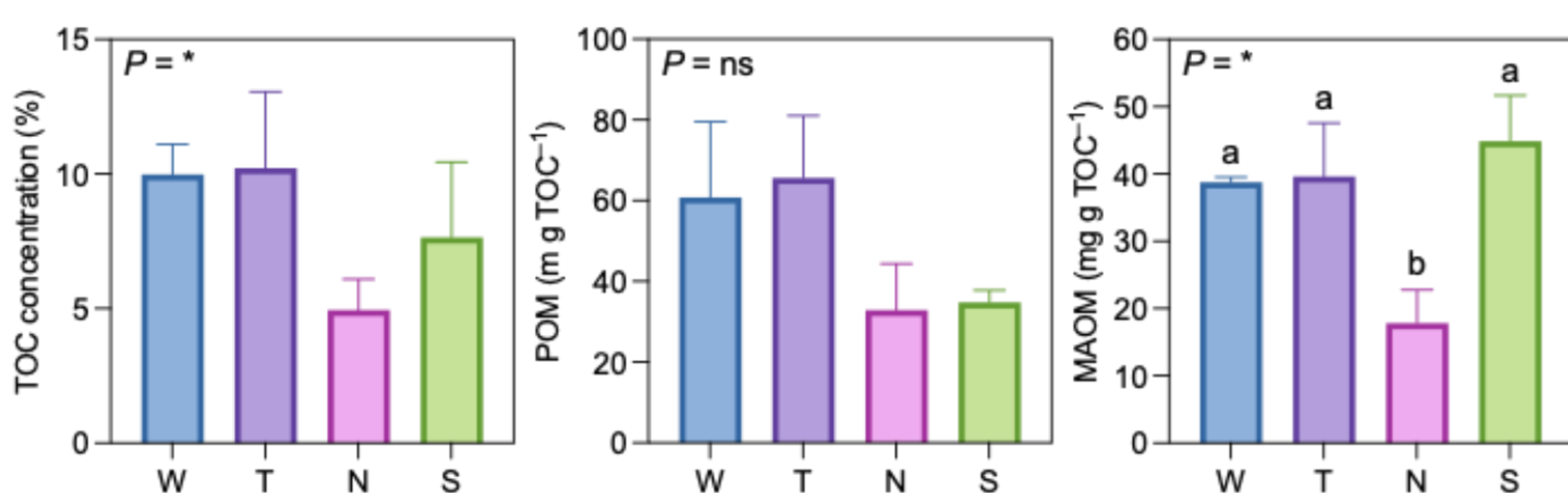


Figure 2. Total organic carbon (TOC), particulate (POM) and mineral-associated (MAOM) organic fractions. Lowercase letters highlight significant differences ($P < 0.05$) among sampling areas according to one-way ANOVA and Tukey's post hoc test.

Conclusions. The ground-based mechanized system salvage logging, carried out before planting, probably affected the carbon and nutrient availabilities as well as the capacity of soil to sequester organic carbon over time. Instead, the natural regeneration, coupled with areal extraction system, preserved soil health suggesting the importance of further investigations.

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