Applied Soil Ecology xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Applied Soil Ecology

journal homepage: www.elsevier.com/locate/apsoil

Applied Field Research Article

Forest humus forms in Italy: a research approach

Anna Andreetta*, Guia Cecchini, Stefano Carnicelli

Department of Earth Sciences, University of Florence, Piazzale delle Cascine 15, 50144 Firenze, Italy

ARTICLE INFO

Keywords:
Forest soils
Humus forms
Mull
Amphi
Moder

ABSTRACT

The environmental factors driving humus form differentiation in Italian forest soils were investigated for Moder, Mull and Amphi models, highlighting the high relative weight of tree species as a predictor. Specific soil-plant-litter- nutrient flow effects were evidenced, representing a direct influence of tree species on humus form development. The effect of parent material on pedofauna activity and composition appeared to be fundamental with key role played by calcium and phosphorus. Specific pathways leading to the evolution of Amphi, a major humus form in Italy, were discussed.

1. Introduction

The study of humus forms is receiving growing interest, after their unveiling as key indicators of soil biodiversity, ecosystem nutrient management strategy (Ponge, 2003) and soil organic carbon storage (Andreetta et al., 2011; De Nicola et al., 2014). Further, humus forms were proposed as practically useful keys to forest ecosystem surveys (Andreetta et al., 2011; Ponge et al., 2014), for their rapid reaction to soil and environment changes (Ponge et al., 2014) and their cheaply and easily observed properties.

Humus forms can be seen as the topsoil architecture resulting from the interaction between the biotic and abiotic components of soil environments (Ponge, 2003; Zanella et al., 2011), where the engineering activity of pedofauna shapes the main morphological characters of the organic and topsoil layers (Ponge, 2003, 2013). Soil microbiota, climate (Aerts, 2006) and, through litter quality and quantity, plants (Hooper et al., 2000), control activity of the soil micro- and mesofauna. Thus, as humus forms are the result of different complex feedbacks, knowing the relative weight of factors driving humus form differentiation is challenging for developing effective forest management strategies.

Recent studies investigated the major determinants for humus forms in France (Ponge et al., 2011), Poland (Labaz et al., 2014), Northern Italy (Ponge et al., 2014) and the entire Italian territory (Andreetta et al., 2016). This work aims: a) to present the methodology adopted to study humus forms during the field survey of the BioSoil project; b) to suggest some explorative data analysis for the interpretation of variables acting on humus development; c) to resume the three humus models based on the results by Andreetta et al. (2016), since this study encompass all the Italian territory, and to compare the main findings with other research conducted in Italy at regional and local scale.

2. Materials and methods

2.1. Field sampling and humus description procedures

238 Italian forest sites were surveyed within the BioSoil project. Sampling was carried out according to standard ICP Forests procedures (FSCC, 2006). For each site, five sampling spots were located within a circle of 25 m diameter (Fig. 1). All spots were similar for slope, rock outcrops and dominant tree cover, while differences in understorey were positively considered in sampling stratification (Fig. 2). Organic horizons were sampled by a mobile sampling frame. Both OF and OH horizons were described separately but sampled together, as their limited thicknesses did not allow consistent separation. Organic horizons were distinguished adding “zo” or “noz” suffixes to OF and OH horizons considering the presence or absence of faunal droppings (zoogenic materials), earthworm burrows, presence of soil fauna visible to the naked eye or with a lens (Figs. 3 and 4).

2.2. Explorative data analysis

Relations between humus forms and different variables were explored using the contingency table method, which treats variables as categorical data. It displays the frequency distribution of the variables in a matrix format that allows to see the proportion of humus forms and soil parameters. The significance of differences was assessed by chi-square statistical test. If the proportion of individuals in the different columns varies significantly between rows, this means that there is a contingency between the two variables.

* Corresponding author.
E-mail address: anna.andreetta@unifi.it (A. Andreetta).

http://dx.doi.org/10.1016/j.apsoil.2017.09.029
Received 18 February 2017; Received in revised form 18 September 2017; Accepted 19 September 2017

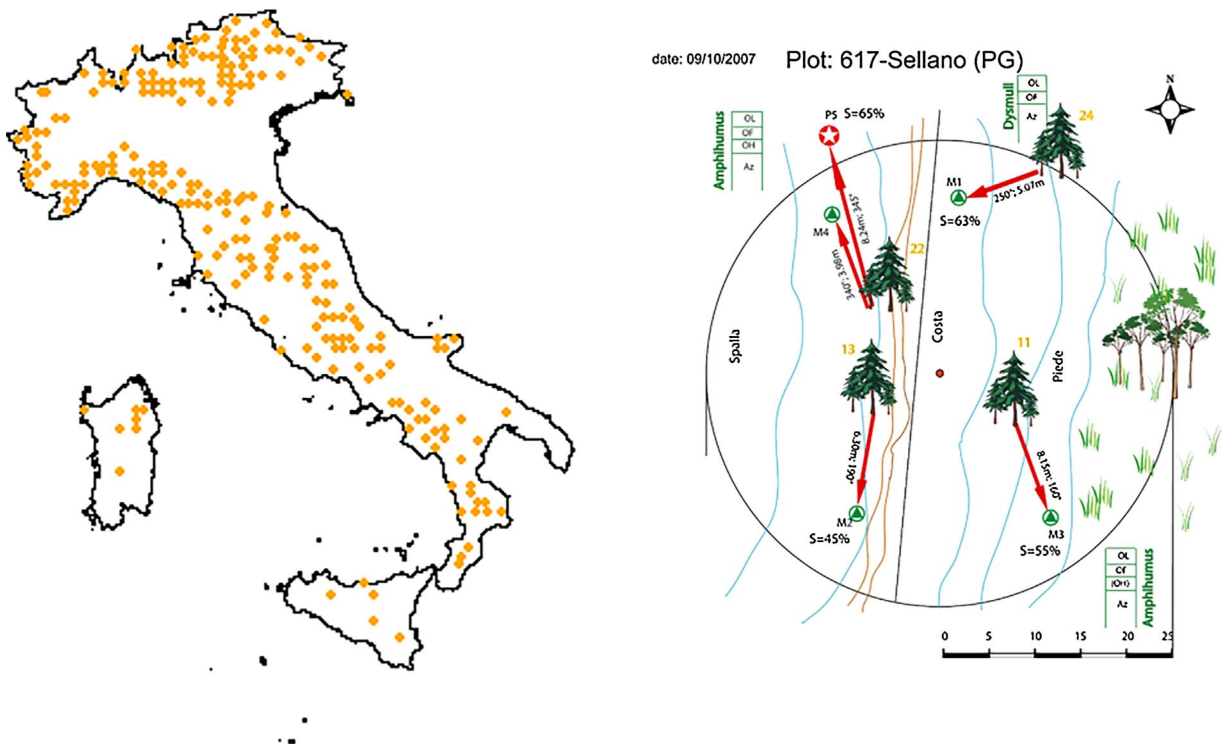

Fig. 1. A) Spatial distribution of the study sites. B) Example of graphical representation of a plot where 4 minipits (green triangle) and the soil profile (star in red) position were reported, and the information on morphology and vegetation were annotated. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

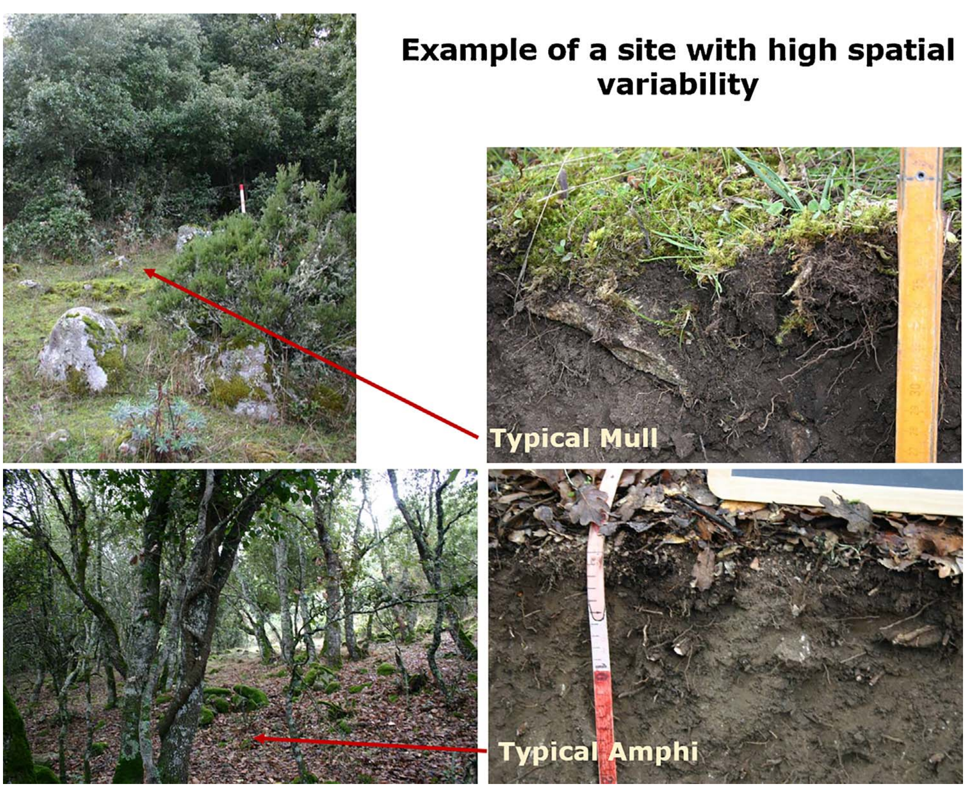

Fig. 2. Example of a site with high spatial variability due to vegetation cover differences. The classification of Mull forms (Humusica 1, article 5: Terrestrial humus systems and forms — Keys of classification of humus systems and forms (Zanella et al., 2017 in press)) shares macrostructured (Eumull and Mesomull) and macro or mesostructured (Oligomull and Dysmull) forms. The classification of Amphi forms shares macrostructured (Leptoamphi and Eumacroamphi) and mesostructured (Eumesoamphi and Pachyamphi) forms. In our figure, "typical Mull" means "humus form with biomacrostructured A horizon and without OH horizon", which corresponds to an enlarged categorie of Eumull (Eu = typical), collecting even Mesomull and some among the Oligo and Dysmull biomacrostructured Mull humus forms. A typical Amphi shows biomacro or biomesostructured A horizons and a continuous (≥1 cm) OH horizon. Two typical Amphi forms are reported in the current classification, Eumacro and Eumesoamphi.