

## Factors influence on humus forming in Castelporziano Reserve, Mediterranean forest ecosystem<sup>☆</sup>

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### ABSTRACT

This contribution aimed to underline the relationship between humus forms, vegetation types and wild mammals disturbance in a Mediterranean forest ecosystem: Castelporziano Presidential Reserve- CPR (Rome, Italy). Humus forms were surveyed along a transect from coast to inland in five forest plant associations representative of evergreen and deciduous forests in the Reserve. The organic carbon-OC and other parameters (pH, Ntot, Moisture) were evaluated in the humus form horizons in the five associations to focus differences in the ecosystem functioning. Principal Component Analysis-PCA was performed on a floristic matrix of 113 plant species × 32 relevés and Pearson correlation test was applied to the PCA axes coordinates versus 38 factors, among which 36 measured in the soil and two indicators of disturbance.

This integrated study between soil and vegetation highlighted four main points: classification and functioning of the humus forms, ecological gradients, wild mammals impact, organic carbon storage.

### 1. Introduction

This contribution in-depth report aimed to underline the relationship between humus forms, vegetation types and wild mammals disturbance in a Mediterranean forest ecosystem: Castelporziano Presidential Reserve – CPR, a Long-Term Ecosystem Research – LTER, where in fact a lot of researches were carried out in the last thirty years. The researches concern different fields of Environmental Sciences such as Botany, Zoology, Geology, Meteorology etc. according to a Program of Environmental Monitoring coordinated and funded by a Presidential team. All these long term researches provided large data-sets collected as databank – SITAC and literature by the Mediterranean Ecosystem Service established inside the Reserve.

The study of humus is one of the most relevant research conducted in the last ten years; it was a pioneer study in the Mediterranean lowland forest, since few data are available in this geographic area (Andretta et al., 2011, 2013; De Nicola et al., 2013, 2014); nevertheless, fortunately the study of humus was supported by a good knowledge of soils, substrates, as well as of flora and vegetation (Pignatti et al., 2001; Testi et al., 2006; Dowgiallo and Biondi, 2001). In this way, it was possible to create an ecological framework very helpful for the forest conservation and management.

The numerous functions of humus, largely described in the

literature, are summarized in some important points concerning particularly the Mediterranean ecosystems:

1. Humus represents a key to detect the quality of a community or ecosystem (Topoliantz and Ponge, 2000);
2. It plays an important protection role of the forest sites through the seed bank conservation (Klinka et al., 1990), as well as of the undergrowth plant species (Ponge, 2003).

Among the several environmental factors influencing the humus forming, we focused carbon storage and wild mammals disturbance representing some of the more significant key factors in the Mediterranean areas and particularly in the CPR.

As concerns the organic carbon storage, while its amount is largely measured in the soil, it is fairly neglected in the orloganic horizons because of the large variation of the humus layers, above all in the temperate forests (Cicuzza et al., 2015). In the Mediterranean Region there are few studies (Andretta et al., 2011; De Nicola et al., 2014) on the carbon sequestration in the orloganic horizons despite its importance in the general contribution to mitigate the effect of global warming.

As concerns the second factor, it is well known that long-term historical disturbance like fires and grazing affected the Mediterranean

<sup>☆</sup> Background music while reading? Roth and Le Roi perform “Papagena / Papageno!”: <https://www.youtube.com/watch?v=87UE2GC5db0&sns=em>

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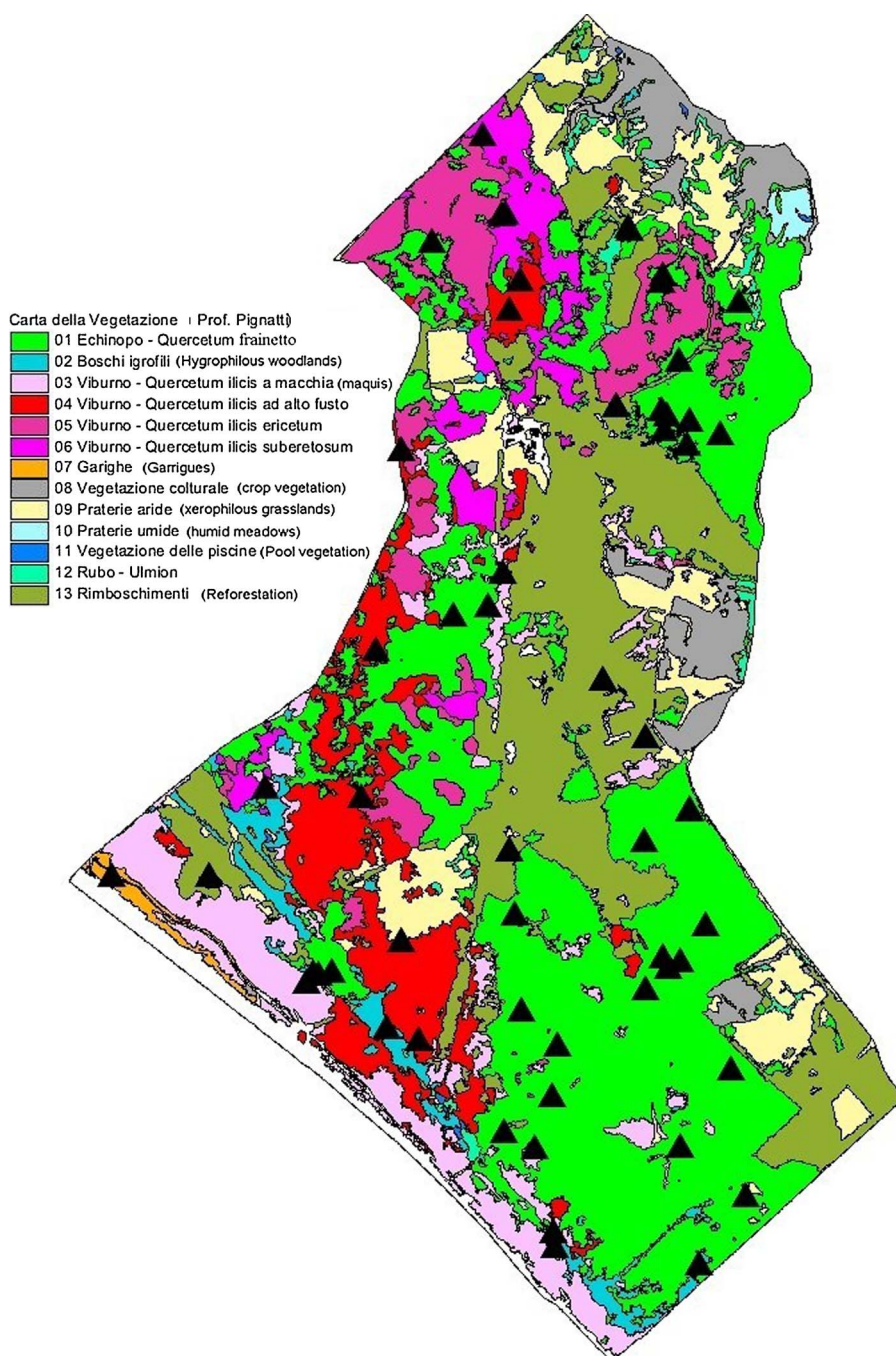


Fig. 1. Location of the 60 humus sampling sites highlighted by black triangles reported on the vegetation map of the Reserve.

areas enhancing, from a side, the biodiversity and, from another side, causing damages to soil and vegetation (Naveh, 1998). CPR, nevertheless was an area subjected to a strict protection regime since the year 1999, is strongly affected by wild mammals impact (Focardi et al., 2015). Mainly the boars (*Sus scrofa majori*) caused the lacking of plant species recruitment in the deciduous oak forests (Fanelli and Tescarollo, 2006) and a change in the structure of the humus systems (De Nicola et al., 2014). The populations of the ungulates have in general high density and are regulated by density-independent (oak seed productivity) and density-dependent factors. Their increase in the last times are due to lacking of predators, both man and animals (Burrascano et al., 2015).

Wild mammals disturbance is powerfully studied in relation to the plant species and communities response, while the effects on soil and mainly on the diagnostic horizons of humus systems and forms are very little known (Sims, 2005; Ponge, 2013; De Nicola et al., 2014).

In order to numerically estimate the degree of impact by the wild boars, we utilised the Hemeroby index (Kowarik, 1990) expressing the degree of past and present human disturbance on ecosystems through the vegetation, according to a ten point scale (Fanelli, 2002; Testi et al., 2012). The lowest value (1) represents pristine environments no more present in Europe, while the highest (10) represents completely altered anthropogenic habitats, and the middle values represent intermediate degrees of disturbance (Kowarik, 1990).

The novelty of the results here presented consists in the effort to focus the interaction between humus forms and wild mammals on a side and on the other side, to follow the carbon storage changes through correspondences and discrepancies between humus and vegetation.

The aim of this study was specifically to verify in the different forest types present, the influence of the two factors above mentioned on the humus forming, also from a quantitative point of view.

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