Soil and pedomesofauna relationships under different forests on a western slope of Etna Volcano

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Introduction

Although the pedofauna influences the processes of pedogenesis and has an important role in the main functional properties of the soil, it has rarely been used as a key-element in defining soil quality. As has been stressed, this is due to the fact that the utility of pedofauna as a soil quality indicator is a function of the definition of soil quality which, in turn, depends on different functions, both biotic and abiotic, performed by the soil. If we consider the biological functions of vegetal, animal and microbiotic activity, the usefulness of the pedofauna, as a diagnostic element of soil quality, reaches its maximum since it is one of the indicators of the biodiversity.

Previous work on soil fauna, dealt with the whole fauna both of litter and mineral horizons, and until now the analyses on invertebrate communities in different horizons of a soil profile are fairly rare.

The aim of this study was *a)* consider the diversity and activity of some selected Orders of the mesofauna in some forest Andisols, in relation to the sampling period, the soil horizons and tree species; b) define the relationships between the whole mesofauna and some selected parameters of soil quality, particularly the cation exchange capacity and the organic matter content.

Study area

The study area is located in the western slope of the Etna Volcano, Sicily, Italy. The climate, from data recorded between 1951-1990 shows an average monthly temperature reaching a maximum of 24.4°C in July and 24.5°C in August and a minimum of 5.1°C in January and 5.3°C in February. The average rainfall is 1143 mm, with a maximum in January and December (132 and 93 mm respectively) and a minimum in June and July (6 and 4 mm respectively). The udometric regime of the soil was defined "udic", and the thermometric regime "mesic". The lithology is formed by lava flows with well preserved surfaces morphology and associated tephra. Soils were classified *Vitric Andosols* (WRB 1998). Land use is woodland that from the highest points to the lowest is covered by beech (*Fagus sylvatica L.)*, down oak (*Quercus pubescens s. l.)* and holm oak *(Quercus ilex L.).*

Materials and methods

We selected three sites under beech (at 1623, 1514, and 1490 m a.s.l.), three under down oak (at 1440, 1400, and 1350 m a.s.l.) and three under holm oak (at 1210, 1150, and 1100 m a.s.l.). The mesofauna activity

was surveyed in the four seasons (December 2010, March, June and September 2011), both in the forest floor (O horizon) and in the first mineral horizon (A horizon) in the three sites under each forest site.

Before sampling, under each forest a soil profile was dug and described in field. In position soil profiles particular care of some similarities, such as the distance from the trunk of the trees and the physical properties (light exposition, pitch, etc.), was taken in order to overcome differences in soil characteristics due to phenomena such as rainwater steam flow. Samples of 500 ml of volume were carefully taken using a square metal sampler, taking always into consideration the same similarities considered in surveying the soil profiles and keeping the O and A horizons separate. Soil samples were settled for one week in an Tullgren Funnels extractor, where, by means of 25 watt light bulb, a temperature gradient is induced, which stimulates invertebrate movement toward the bottom of the funnel and than into an alcohol vial where they are collected. The mesofauna extracted was identified to the Order or Class level.

Results and discussion

The more significant results pointed out that the pedomesofauna in winter under beech moves from the organic layer to the mineral horizon, while at lower elevations (under oaks) there is equilibrium in the pedomesofauna quantity and activity between the two layers.

The more diffused species are Acari and Collembola, which were respectively 74% and 19% of the whole mesofauna. Even if they may be reasonably used as bioindicators of the soil quality, as shown by previous surveys, in our survey they do not show any significant correlations with the contents of organic matter and the cation exchange capacity of the mineral horizons of the investigated soils.

In any case, the high biodiversity observed confirms the good state of health of these ecosystems. Highest values of individuals were observed in winter. Under the oaks they were detected in the O horizon, while under the beech in the A horizon. Another evident difference was observed between the trend of pedomesofauna values in soils under deciduous oak (*Quercus pubescens*) and the evergreen one (*Quercus ilex*). Under this latter, in the O horizon the pedomesofauna is still high in spring and decreases dramatically in summer, when, probably due to a vertical migration, it increases in the A horizon; on the contrary under deciduous oak we observed the highest values of the O horizon in autumn-winter. Under the beech the minimum values of pedomesofauna, in A horizon, occurred in summer. It seems that differences in the microclimate among the selected areas together with the differences in the palatability of the forest floor, could be the reasons of the winter vertical migration of pedomesofauna under beech, the summer vertical migration under evergreen oak and the intermediate situation highlighted under deciduous oak.

Conclusions

Soil mesofauna may be used as indicator of soil quality and biodiversity. The richness and diversity of mesofauna populations in the forest soils investigated is affected by climate gradient, tree species, soil horizons and seasonal periodicity. No significant relationship between pedomesofauna and chemical or physical soil quality parameters has been found. The high biodiversity observed, in terms of taxa richness and individual abundance, confirms the good state of health of these environments.