Earthworm diversity and soil-related processes in disturbed Caspian forest

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INTRODUCTION

Soil formation processes are affected by different disturbances in forest ecosystems. One of the most important effects of windthrow is through the influence on the rate and quality of soil formation processes. Soil processes are controlled by a set of relatively independent state factors including climate, organisms, relief, parent material, time and by a group of interactive controls such as disturbance regime and human activities. Earthworms are perhaps the most important soil organisms in terms of their influence on organic matter breakdown, soil structural development, and nutrient cycling, especially in productive ecosystems. Despite of the vast increase in scientific literature on earthworms in recent years, much remains to be known in their basic biology and ecology. However, determine of relation among biomass and diversity of earthworms with pit and mound disturbances (created following tree uprooting, see Fig. 1) and soil properties are essential for management of forest ecosystems. The goal of this study was to investigate windthrow effects on soil properties, earthworm biomass and species diversity in hyrcanian forests of Iran that is the first survey in these forests.

Fig. 1. Pit and mound micro topography.

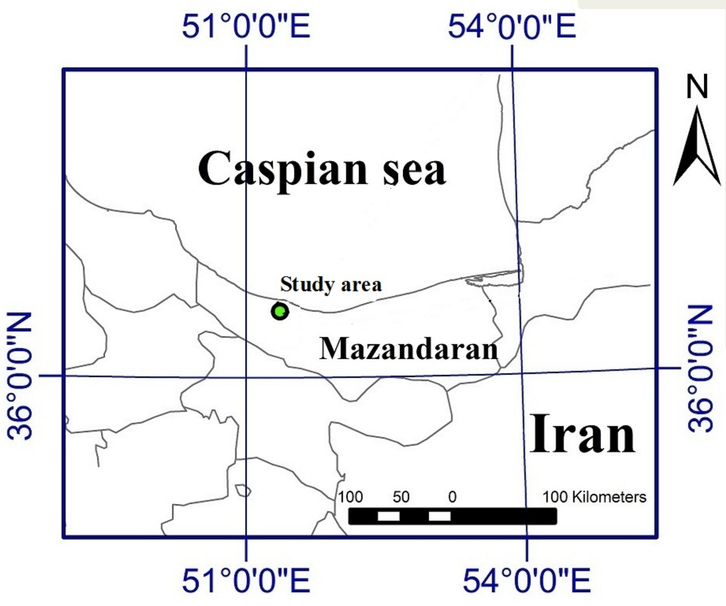


Fig. 2. Location of the study area in the Mazandaran province, Northern Iran.

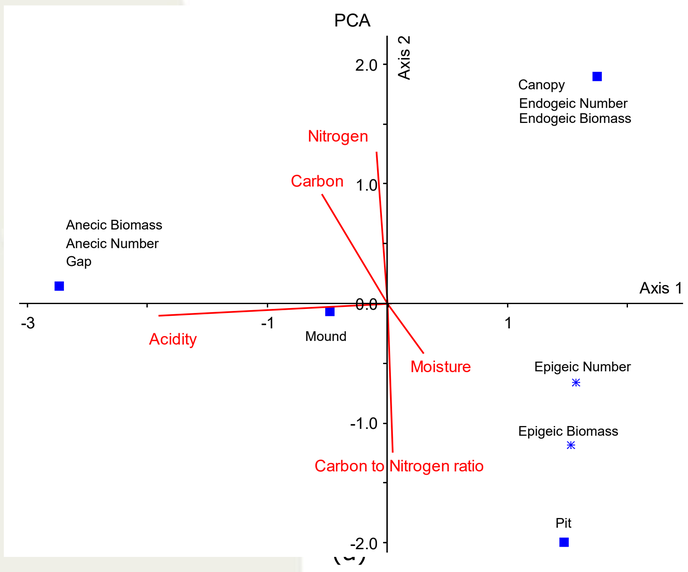
MATERIALS AND METHODS

This research performed in Sardabrood forests that are located in the lowland and midland of Mazandaran province in north of Iran (Fig. 2). Twenty seven single - tree gap sites in mixed beech forests were found, seventeen sites dominated by beech (Fagus orientalis Lipsky) and ten by hornbeam (Carpinus betulus L.) at 700 - 1300 m altitude range. In the all of areas, the pit and mounds resulted from the fall of a single tree. Four microsites were distinguished including mound top (mound), the pit bottom (pit), the gap in the canopy (gap) and closed canopy (canopy) at each site. Soil samples were taken at 10cm depth from all microsites to laboratory analysis. The earthworms were collected simultaneously with the soil sampling by hand sorting, washed in water and weighed with mili gram precision. Species of earthworms were identified by external characteristics using the key of BOUCH (see Fig. 3). Analysis of whole data was done in SPSS Ver. 13.5 of statistical program. Factor analysis is statistic technique for achievement to complex relationships among variables. For this purpose, relationships between microsites and earthworms species were analysed by Principle Component Analysis (PCA).

Fig. 3. Earthworm's representative of different ecological groups. (a) Epigeic species, (b) Endogeic species, and (c) Anecic species.

MAIN RESULTS

Analysis of data showed that number and biomass of earthworm's ecological groups had significant differences among microsites and sites. Earthworm's number and biomass had more amounts in canopy and the least were observed on mound microsites. Hornbeam site involved more abundance of earthworms in comparison to beech site. In beech site, PCA showed that percentage of eigenvalue for the first and second axis are about 53.91% and 31.69%, respectively. In hornbeam site, the first second of the PCA accounted for 81.38 % of the total variance; 48.13 % by axis 1, 33.25 % by axis 2. Based on our data, the windthrow generally reduced the activity and abundance of the earthworms regarding to the changes in soil physico-chemical properties (Fig. 4).



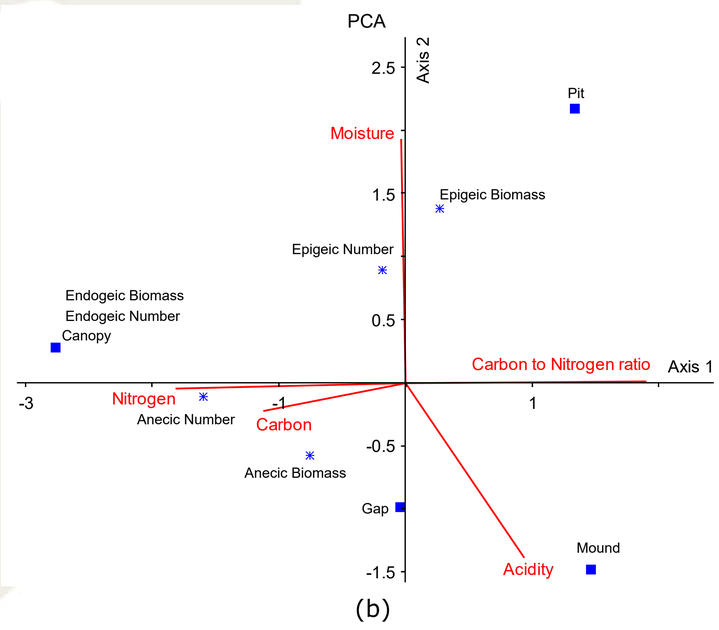


Fig. 4. PCA bibplots of microsites, soil characteristics and earthworm species in beech (a) and hornbeam (b) sites.