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Short communication

Community structure and seasonal variations of soil microarthropods during environmental changes

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ABSTRACT

The community structures and seasonal changes of soil microarthropods in a natural sessile oak (*Quercus petraea* L.) stand and an adjacent Scots pine (*Pinus sylvestris* L.) plantation in Belgrad Forest, Istanbul, Turkey were investigated between November 2008 and October 2009. Microarthropods were sampled monthly, using steel soil corers. The mean annual abundances of microarthropods were 42,851 individuals m^{-2} in the oak stand and 42,276 individuals m^{-2} in the Scots pine plantation. The Shannon diversity index (H') of microarthropods in the Scots pine stand was 9.6% higher ($p < 0.05$) than those of the native oak stand. Although conversion of a sessile oak stand to a Scots pine plantation did not impact the abundance of soil microarthropods, it increased their diversity.

1. Introduction

Soil arthropods play significant roles in ecosystem processes (Birkhofer et al., 2011; Cole et al., 2006; Cragg and Bardgett, 2001; Çakır and Makineci, 2009). Conversely, arthropod diversity (Fig. 1) may be affected by aboveground plant diversity (Sabais et al., 2011; Salmon et al., 2008). The diversity and abundance of soil fauna that play crucial roles in aboveground and belowground processes are regulated by regional factors such as climatic conditions, parent material, altitude, forest type, and succession stage (Grossi and Brun, 1997; Materna, 2004), along with stand variables such as canopy, light intensity, predators, humus form, nutrient availability, and soil pH and moisture content (Salmon et al., 2008). It is well-known that human disturbances such as reforestation and land use changes may have significant effects on biodiversity (León-Gamboa et al., 2010; Sala et al., 2000; Vitousek et al., 1997). Thus, the objective of this study was to determine the effects of tree species on the soil ecosystem, and to compare the diversity, abundance, and community structure of soil microarthropods in a Scots pine (*Pinus sylvestris* L.) plantation and an adjacent original sessile oak (*Quercus petraea* L.) stand.

2. Materials and methods

The research area is in Istanbul province in Turkey, 41°09′–41°12′ N and 28°54′–29°00′ E (Fig. 2). Mean annual precipitation is 1074 mm and mean annual temperature is 12.8 °C. The soil is well-drained, with a loamy texture, and it is in the Luvisol soil group. Altitude is 140 m, and the slope is 10–15%, with a southern aspect (Akburak et al., 2013).

The study sites were an 84-year-old natural sessile oak (*Quercus petraea* L.) stand (Fig. 3a) and an adjacent Scots pine (*Pinus sylvestris* L.) stand (Fig. 3b) that had been converted from its original sessile oak population 62 years ago. Average tree diameter, average tree height, and stand density were 26.6 cm, 20.0 m, and 444 trees ha^{-1}, respectively in the oak stand, and 27.2 cm, 18 m, and 1005 trees ha^{-1}, respectively, in the Scots pine stand.

Three sampling plots were established at random locations within each stand. In each plot, three locations were randomly chosen, then used each month from November 2008 to October 2009 for soil and litter sampling. Litter samples were collected from an area of 25 cm^2 and the humus was classified in the field based on European Humus Research Group guidelines (Zanella et al., 2011, 2009). Three soil core samples (5 cm in diameter and 5 cm in depth) were taken randomly from each plot to collect microarthropods (2 sites × 3 replicates × 12 months = total 72 cores). Microarthropods were extracted using modified Berlese–Tullgren funnels (Coleman et al., 2004; Murphy, 1962), then sorted, identified, and counted under a stereoscopic binocular microscope (Leica S8 APO; Leica Microsystems, Germany) to order or family according to Dindal (1990).

Soil and litter total carbon and nitrogen contents were measured using a CN analyzer (LECO, St. Joseph, MI, USA). Soil bulk density (D_b) was determined with the intact core sampler method (Blake and Hartge, 1986). Soil pH and electrical conductivity (EC) were measured with a

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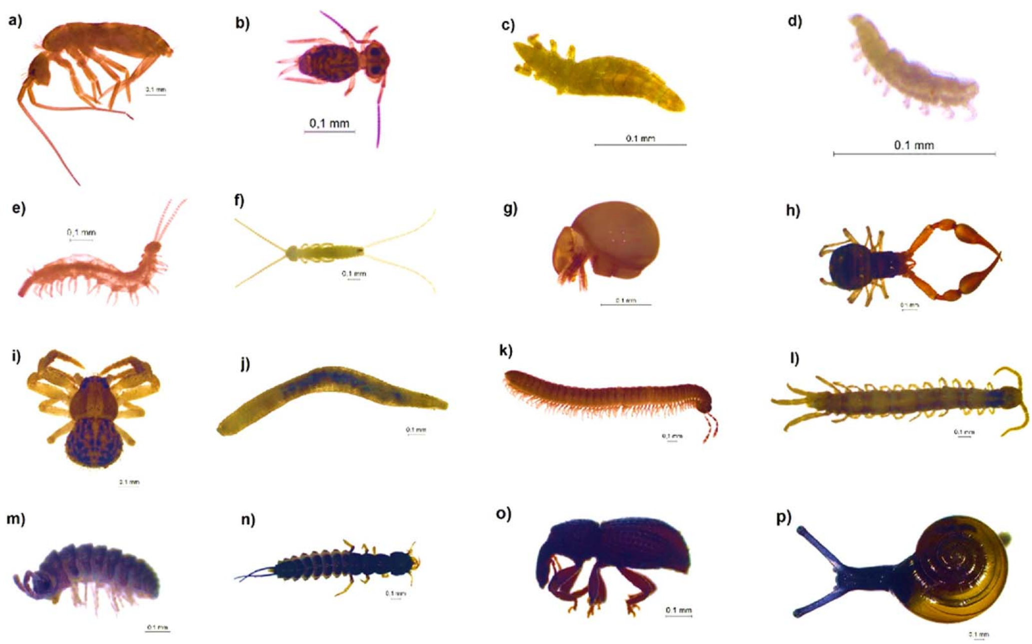

Fig. 1. Diversity of litter and soil fauna in Belgrad Forest, Istanbul, Turkey. a, b) Collembola, c) Protura, d) Pauropoda, e) Symphla, f) Diplura, g) Acarina, h) Pseudoscorpionida, i) Litter spider, j) Lumbricina, k) Diplopoda, l) Chilopoda, m) Isopoda, n) Coleoptera larvae, o) Coleoptera, p) Gastropoda. (Photo by M. Cakir).

microprocessor pH meter and electrical conductivity meter, respectively. Moisture was calculated as the difference in weight between fresh and dried soil samples (samples were dried at 105 °C).

Independent samples *t*-tests were used to compare the humus characteristics and soil properties of the two stands. To test the differences in microarthropod distribution and diversity, species richness, diversity index, and evenness were calculated. Abundance (*A*), species richness (*S*), and Shannon's diversity index (*H*′) were used as community parameters (Shannon and Weaver, 1949). The effects of the investigated variables on soil microarthropod community composition were estimated using the redundancy analysis (RDA) ordination technique in the CANOCO 5.0 software program (Hill and Gauch, 1980).

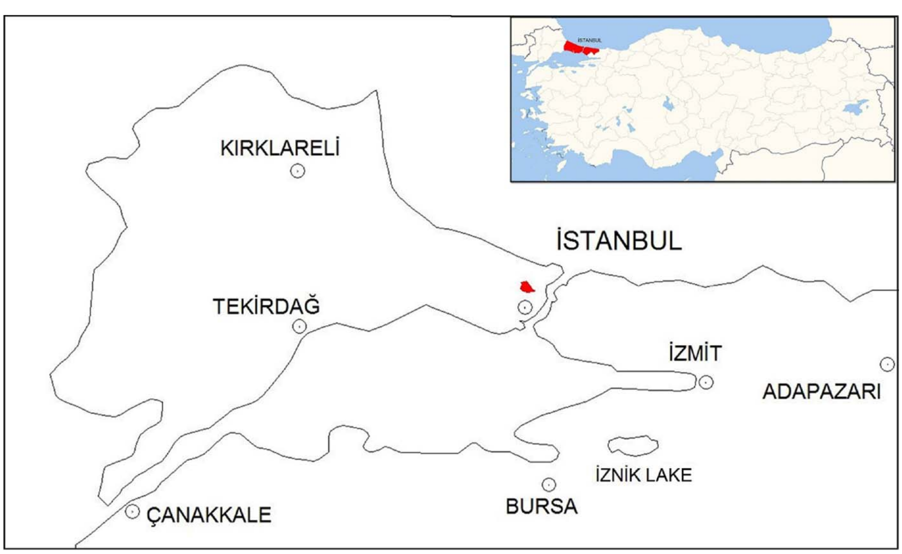

Fig. 2. Location of sampling sites in Belgrad Forest, Istanbul, Turkey, are shown in red.