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Effect of soil properties on the distribution of earthworms in Zagros Mountains

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Abstract:

Earthworm communities are generally very sensitive to physico-chemical properties of the soil, which directly or indirectly influence the availability of resources for earthworm survival. Soil properties, such as soil quality, pH, moisture, and texture, affect the diversity and abundance of earthworm's species. In this study earthworm samples were collected from 35 different sites at four habitats (grasslands, farmlands, mixed forests, and Highlands). Earthworms were sampled by the hand-sorting method up to 30 cm deep using quadrats for each sampling site. The preserved samples were studied morphologically and dissected for studying diagnostic taxonomic characteristics. Soil was analyzed for texture, pH, electrical conductivity (EC), and moisture. In this study, 17 species of earthworms have been identified. The results of statistical analysis showed that the abiotic factors (pH, moisture, and EC) have significant effects on the distribution of earthworms and species richness. Simpson's diversity index was 0.067, 0.071, 0.081, and 0.091 for mixed forests, farmlands, highlands, and grasslands, respectively. This study revealed that diversity of earthworm species increases with increasing EC and moisture but decreases with increasing pH. Jacquard similarity index based on the presence and absence of species showed the highest similarity between grassland and mixed forest habitats (0.714) and the lowest similarity between farmland and highland habitats (0.438).

Keywords: Diversity; Species richness; Moisture; pH; Electrical conductivity

Introduction

Soil biodiversity is vital to humans as it supports a wide range of ecosystem processes, functions, and services (Jouquet et al., 2014). The fertility of soil depends on the biological diversity and functionality. Earthworms have been recognized as the farmer's friends, natural ploughmen, soil ecosystem engineers and intestines of earth by several authors. Earthworms can significantly influence soil physical, chemical, and biological properties, hence improving the fertility and structure of soils (Singh et al., 2016). Earthworm communities consist of many different species, with different role in soil processes. To understand the function of earthworms in soil ecosystems, species identity and habitat preferences needs to be assessed. Research on earthworm species diversity has been carried out in several parts of the world, but only in a limited number of geographical regions (Philips et al., 2019). Despite previous taxonomic surveys performed in the Zagros area, very little is known on the effects of abiotic factors on earthworm community in this part of Iran.

Materials & Methods

The study was conducted at 35 different sites in western areas of Iran. An extensive survey of earthworms was done in various environmental niches such as grasslands, farmlands, mixed forests, and Highlands (Figure 1).

Soil was taken from the sites for physico-chemical analyses. Soil was analyzed for EC, moisture and pH. EC and pH were measured using a digital pHmeter (Eutech Instruments, PCSTestr 35 series). To compare the moisture, pH, and EC between habitats, Kruskal–Wallis test was applied. The correlation between species diversity and moisture, pH, and EC was assessed using Spearman test.

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Results

In this study, 17 species of earthworms have been identified, namely *Amyntas corticis*, *Aporrectodea caliginosa*, *A. jassyensis*, *A. longa*, *A. rosea*, *A. trapezoides*, *Dendrobaena byblica*, *D. hortensis*, *D. pentheri*, *D. veneta*, *Dendrodrilus rubidus*, *Eisenia andrei*, *E. fetida*, *Eiseniella tetraedra*, *Helodrilus patriarchalis*, *Octolasion lacteum*, *Perelia kaznakovi*. The greatest diversity was found in grasslands. Species richness increased with increasing EC and moisture values, but decreased with increasing pH (Figures 2-4).



Figure 1 Different habitats where earthworms were collected.

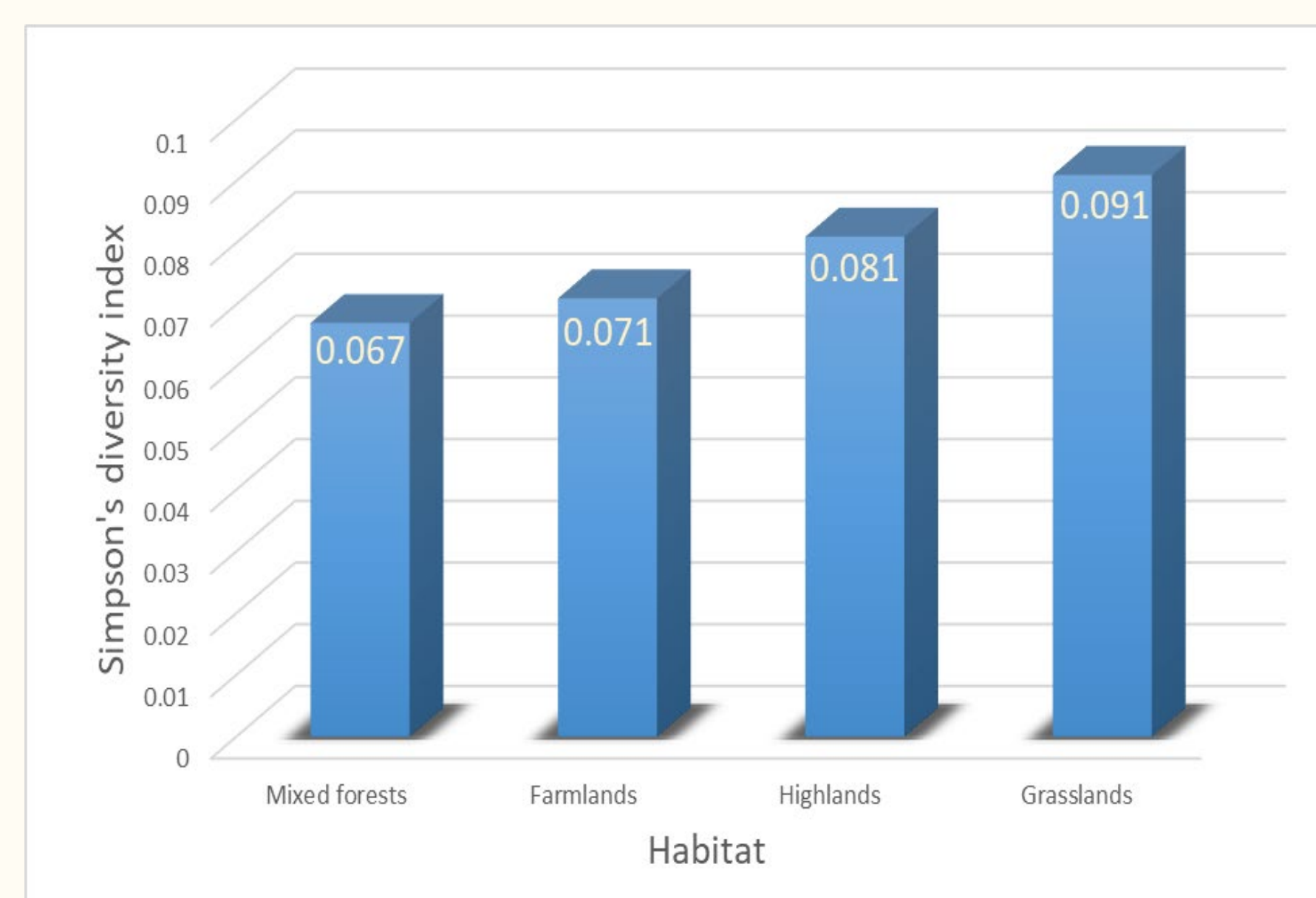


Figure 2. Simpson's diversity index at the four different habitats.



Figure 3. Some earthworm species collected from different habitats.

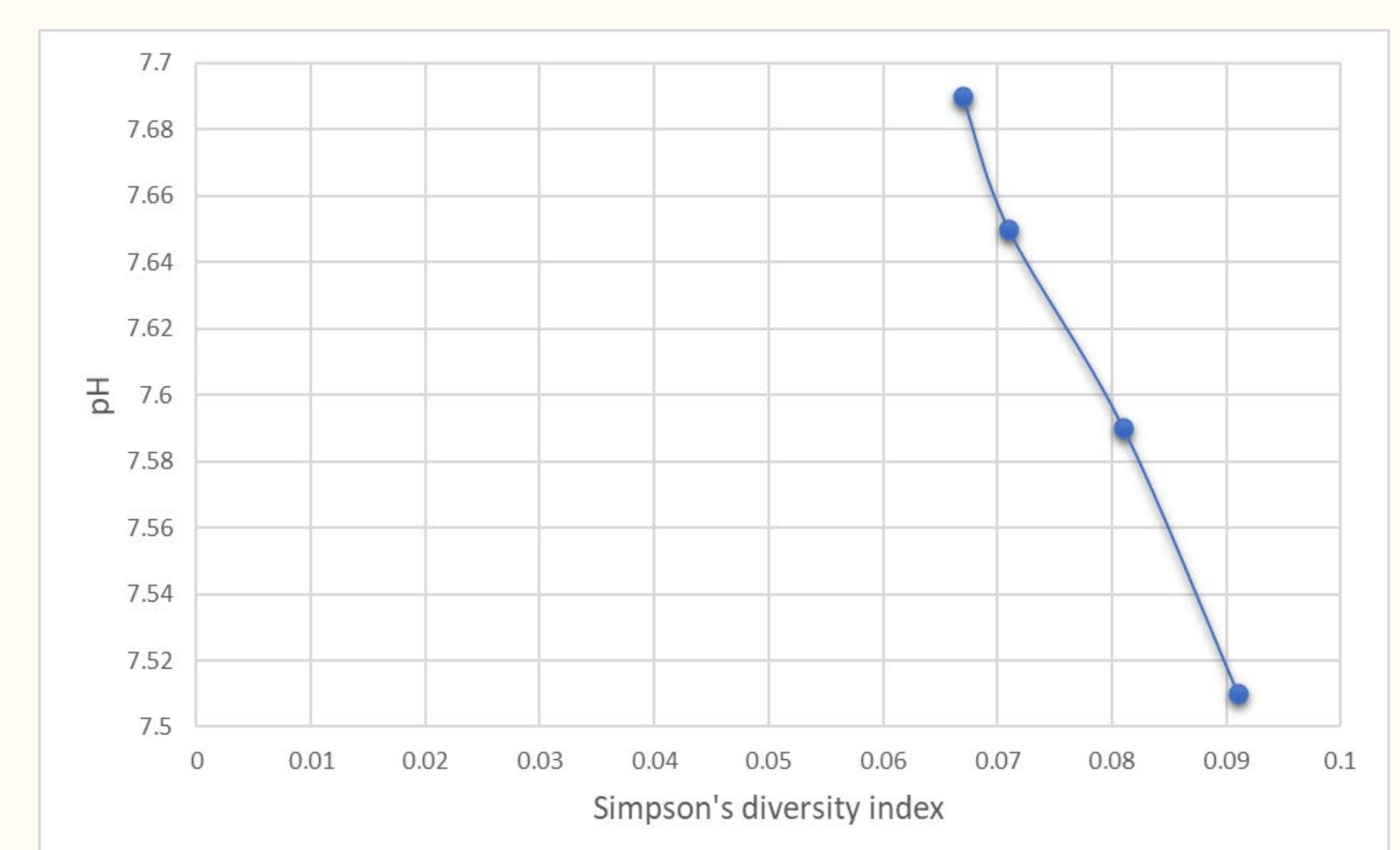


Figure 4. Relationship between Simpson's diversity index and pH values measured at the four sampled habitats..

Discussion & Conclusions

This study provides essential information regarding the effects of abiotic factors of soil on the diversity and habitat preferences of Iranian earthworm species. Higher species richness was recorded in grasslands followed by Highlands. This result contrasts with that of Latif et al. (2021) who reported higher diversity in mixed forests from the Alorz region. The highest earthworm diversity (6 species) was recorded in one location. Edwards and Bohlen (1996) indicated that the average number of species per location ranges between two and five.

Earthworm populations are very sensitive to land use and plant cover, which directly affects soil characteristics (Amador et al. 2013). This study showed that pH and moisture were the main drivers of earthworm community composition.