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Effect of Plateau Pika (*Ochotonacurzionae*) Disturbance on Soil Microelements Content in Alpine Meadow

Tingting Jia
Lanzhou University, China

Zhenggang Guo
Lanzhou University, China

Yu Xiao
Lanzhou University, China

Yuying Shen
Lanzhou University, China

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Effect of plateau Pika (Ochotonacurzionae) disturbance on soil microelements content in alpine meadow

TingtingJia, GuoZhenggang*, Yu Xiao, Yuying Shen
State Key Laboratory of Grassland Agro-ecosystems, Lanzhou University, Lanzhou, China
*Corresponding author e-mail : guozhg@lzu.edu.cn

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Introduction

The plateau pika (*Ochotonacurzoniae*) creates the extensive disturbance on alpine meadow ecosystem in the Qinghai-Tibetan Plateau (Smith and Foggin, 1999, Delibes-Mateos *et al*., 2011), especially on soil nutrient (Davidson *et al*., 2012). Previous studies show that intermediate active burrows of plateau pika improved soil macro-element (organic matter, total nitrogen and total phosphorus) in alpine meadow (Guo *et al*., 2012). However, there is little knowledge about the underlying contribution of plateau pika disturbance in determining soil microelement in alpine meadow. The density of active burrow entrances is used to divide the disturbances levels of plateau pika to determine the effect of various disturbance levels of plateau pika on soil microelement content of alpine meadow in the Qinghai-Tibetan Plateau in this study.

Materials and Methods

The study area is located in the Maqu County in Gansu Province on eastern Qinghai-Tibet Plateau (33°06′30″~34°30′15″ E, 100°40′45″~102°29′00″ N), China. We use the density of active plateau pika burrow entrances as an index for disturbance level by plateau pika. Data collection was conducted during the summer (late July to early August) of 2012 on winter pasture where the livestock were excluded during summer period. Thirty-six plots of 25 m×25 m (625 m^2) were randomly selected on a flat meadow area, with the distance between plots ranging from 25 m to 30 m. Whether burrow entrances were used at the sampling period (active) was assessed in May 2012 over three days. Burrow entrances were blocked with soil at night (19:00) and the entrance opened the next morning was regarded active. The mean number of active burrow entrances over the three day period was obtained and used as an index of plateau pika activity for that plot. In each plot, 5 subplots with size of 1m×1m were arranged in diagonals. Plant height and plant cover in each subplot and the area of bare patch in each plot was measured. Total plant cover was measured using 100 random points (1 mm wire), and heights were measured using the mean value of 100 random measurements (ruler) within each subplot. The area of each bare patch was determined by dividing each into regular shapes (such as: square, rectangle, rhombus, triangle) and the areas of these regular shapes summed to give the area of each bare patch. The average plant height and plant cover of 5 subplots was considered the plant height and plant cover of each corresponding plot. These four parameters (the density of active burrows, plant height, cover, and area of bare patches) were used as variables to categorize the 36 plots using Cluster Analysis. Four categories were obtained. According to the mean densities of active burrow entrance of the 4 categories, 12 from the 36 plots were selected and categorized into I, II, III and IV disturbance level, each with 3 replicates. The number of average active burrow entrances of I, II, III and IV were 160, 240, 336, and 496 active burrow entrances $hectare^{-1}$, respectively. The twelve selected plots were fenced to exclude grazing by wild herbivores (Equus kiang; Procaprapicticaudata).

In each selected plot, 5 subplots, 0.5 m×0.5 m (0.25 m^2), were redesigned with ‘‘W’’ distribution to collect soil sample and the distance between subplots was over 5 m. At each subplot, soil samples were taken from the center and corners of each subplot at 0–10 cm and 10–20 cm layers. In each layer, a composite sample was prepared from soil collected at five sampling points using a knife made from bamboo to prevent contamination of the samples with metal from a metal sampler. Soil samples were air-dried and passed through a 2-mm sieve before chemical analysis. The Copper, Zinc, Manganese, Magnesium (Cu, Mn, Zn, Mg) content in the soil samples was determined by atomic absorption spectrophotometer on the digested dried soil material extracts obtained by oxidative wet digestion using a mixture of nitric, sulfuric and perchloric acids.

Differences in soil Cu, Mn, Zn, Mg content of four disturbance levels of plateau pika were analyzed by using one-way ANOVA.

Results and Discussion

At both soil depths, the soil Cu content was the greatest at the plots with level III disturbances (Fig. 1 A), indicating that the intermediate disturbance by plateau pika increased soil Cu content. The soil Mn content at a depth of 0-10cm was not different between plots with level I and IV disturbances, but it was significantly greater than those in plots with level II and III disturbances (Fig. 1B). The soil Mn content at a depth of 0-10 cm and 10-20cm decreased from disturbance level I to disturbance level II, and increased from disturbance level II to disturbance level Ⅳ and was the lowest at disturbance level II (Fig. 1B). With the increase of disturbance level, the soil Zn content increased at a depth of 0–10 cm, while gradually declined at 10-20cm (Fig. 1C). The soil Mg content at a depth of 0-10cm was not significantly different across different disturbance levels by plateau pika; however, the soil Mg content at a depth of 10-20cm was the greatest at the plots with level I disturbances, and was significantly higher than those in plots with level II disturbances and level III disturbances (Fig. 1D).

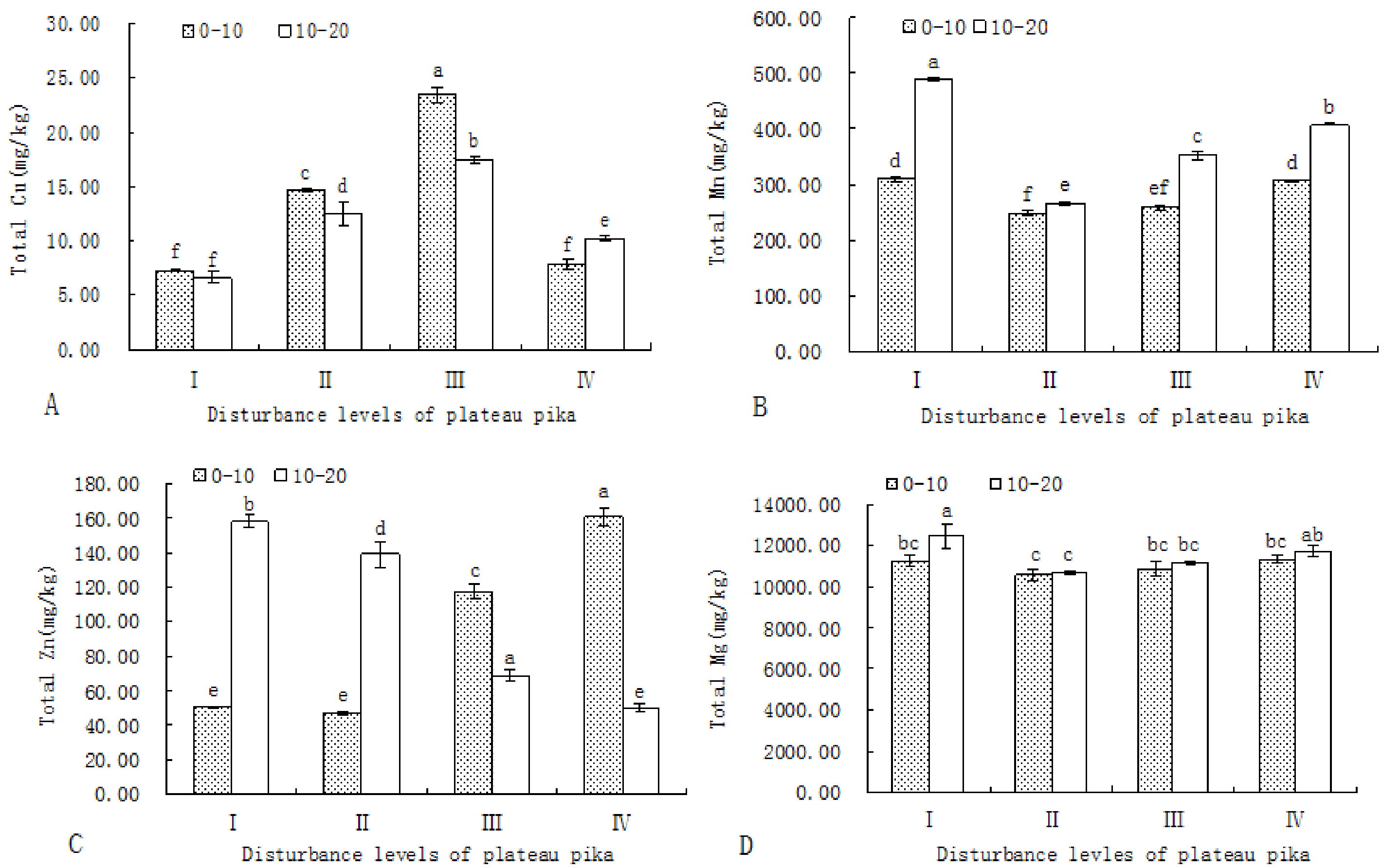

Fig. 1 Effects of disturbance levels of plateau pika on soil Cu content (A), Mn content (B), Zn content (C), and Mg content (D). (Note: the bar with the same letter was not significant at 0.05 level.)

Conclusion

The response of soil microelement content to plateau pika disturbance was different, indicating that intermediate disturbance by plateau pika increased soil Cu content, but decreased soil Mn content; with the increase of disturbance level, the soil Zn content increased at a depth of 0–10 cm, but declined at a depth of 10-20; and the soil Mg content at a depth of 0-10cm was not related to disturbance levels of plateau pika.

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