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ORIGINAL RESEARCH

Characteristics of Ecological Distribution of Soil Microarthropod Communities in the Wetlands of the Lhasa River on the Qinghai-Tibet Plateau

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Abstract The Lhasa River Basin is one of the typical distribution regions of alpine wetlands on the Tibetan Plateau. The aims of this study were to analyze characteristics of distribution of soil microarthropod communities and relationship with soil factor in this area. We selected six wetlands as the study areas. Soil microarthropods were extracted from the soil samples collected from each habitat in August 2009 and 2010. The soil microarthropod communities consisted of 30 taxa and 3356 individuals. Overall, habitat of *Kobresia pygmaea* + *Potentilla anseriana* had a greater abundance than all of the other habitats. The soil microarthopod communities exhibited significant differences among the habitats at the 0–10, 10–20 and 20–30 cm depth. Dominant groups increased as the soil layer deepened. Oribatida was the dominant order in three soil layers, however, Isotomidae was the only dominant family at the 0–10 cm depth. Canonical correspondence analysis (CCA) showed that soil microarthopod communities was significantly correlated with soil total K content in the 0–10 soil layers. However, soil microarthopod communities was significantly correlated with soil available N content in 10–20 cm soil layer, soil total N content in the 20–30 cm soil layer.

Keywords Soil microarthropods · Ecological distribution · Wetland · Lhasa River · Qinghai-Tibet Plateau

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Introduction

The Qinghai-Tibet Plateau is an ecological security barrier of southwestern China, and has a great effect on China and the Eastern Hemisphere. The Qinghai-Tibet Plateau plays a driving and increasing effect depending on the degree of ecological sensitivity in global change (Zhang et al. 1982; Yang and Zheng 2004). The wetlands of the Qinghai-Tibet Plateau exhibit wide distribution. It is unique wetland type in China (Liu et al. 1999). The plateau wetlands perform many ecological functions, such as supplying water and regulating climate. Previous studies have mainly focused on the plants and vertebrates of the Qinghai-Tibet Plateau, and research regarding soil microarthopods has rarely been reported (Yin et al. 2010a).

Soil microarthopods are an important component in wetland ecosystems, and a key point in the food chain (Yin et al. 2010b; Bischof et al. 2013; Wyss et al. 2013). Soil microarthopods serve as a nutrition mediator between the primary producers and secondary consumers, making them an important food. They also promote the decomposition of soil organic matter, accelerate the circulation of nutrient elements, regulate energy flow, and monitor and indicate the soil environment (Wardle 1995; Einar 2000; Silvan et al. 2000; Rohan and Richard 2001; Wu et al. 2002; Li et al. 2005; Davis et al. 2006; Wu et al. 2008; Chen et al. 2011).

This is the first time a study has been conducted on the characteristics of the ecological distribution of soil microarthropod communities in the wetlands of the Lhasa River on the Qinghai-Tibet Plateau. The objectives of this study were to: (1) describe the soil microarthopod community structure and diversity characteristics in the wetlands of the Lhasa River on the Qinghai-Tibet Plateau; (2) reveal the effect of soil factors on soil microarthopod community in the wetlands of the Lhasa River on the Qinghai-Tibet Plateau.

Materials and Methods

Study Site

The experiment was performed in the Lhasa River Basin, China (29°22 ′28 ″-29°53′ 18″N, 90°43′12 ″- 91°43′ 12″ E). The wetland area is 209,322.26 hm^2, accounting for 6.37 % of the total land area of the basin (Zhang et al. 2010), with an average elevation of 3650 m. The area has a temperate plateau subarid climate with a mean annual temperature of 7.5 °C, with −2.2 °C in January and 15.5 °C in July. The mean annual precipitation ranges from 200 to 500 mm, and the frost-free period lasts for 100 to 120 days per year. Meadow soil is the most dominant soil type. The zonal vegetation of the area is alpine meadow with shrubs and bushes, and there are no native forests (Zhang et al. 1982; Yang and Zheng 2004).

Sampling Design

To analyze the characteristics of ecological distribution of soil microarthropod communities in the wetlands of the Lhasa River, we selected six habitat types as the study areas. Six habitats were divided based on their vegetation community features and elevation (Table 1).

The plots (50×50 m) were established using permanent signs in each of the six habitat types. Within each plot, four subplots were randomly selected at 5 m horizontal intervals, and 10×10 cm areas were collected from the 0–10, 10–20 and 20–30 cm soil layers in each subplot in August 2009 and 2010. Therefore, a total of 144 soil samples were collected (6 habitats×1 plots×4 subplots×3 layers×2 sampling periods). In the laboratory, soil microarthropods were extracted from each of the soil samples using a Tullgren funnel extractor for 24 h at 40 °C, then preserved in 75 % alcohol. They were then counted under a stereoscopic microscope (OLYMPUS SZX16), and identified to order or family levels (Yin 1998).

Soil samples (0–10, 10–20 and 20–30 cm soil layers) were collected at each subplot. The soil samples were then used for determination of available N, P, K, total N, P, K, organic matter, pH and water content. Soil properties in different habitats are shown in Table 2.

Statistical Analysis

The data from the 2009–2010 were combined to evaluate the total microarthropod abundance (ind. m^{-2}). The ecological characteristics of soil microarthopods community were quantitative analysis by index of Shannon-Wiener (Weaver and Shannon 1949).

Shannon-Wiener diversity index (H'):

$$H' = -\sum_{i=1}^{s} P_i \ln P_i$$

where S is the number of groups, and P_i is the ratio of individuals to the total collected individuals in no. i group for each habitat.

Table 1 Location and vegetation characteristics of habitats

Habitat code	Pant community	Wetland	Location	Elevation (m)	Main vegetation	Coverage (%)
1	*Carex orbicularis* + *Potentilla anseriana*	Lalu wetland	29°40′29.0″N 91°06′18.0″E	3638	*Carex orbicularis*, *Potentilla anseriana*, *Ranunculus indivisus* etc.	100
2	*Blysmus sinocompressus* + *Deschampsia caespitosa* + *Potentilla anseriana*	Tanggaguo wetland	29°22′28.4″N 90°43′11.5″E	3626	*Blysmus sinocompressus*, *Deschampsia*, *Carex orbicularis*, *Potentilla anseriana*	90
3	*Potentilla anseriana* + *Kobresia pygmaea*	Jiangxia wetland	29°51′50.1″N 91°21′33.8″E	3740	*Potentilla anseriana*, *Kobresia pygmaea*, *Kobresia persica*, *Glaux maritime* etc.	85
4	*Astragalus strictus* + *Pennisetum centrasiaticum*	Yarong wetland	29°54′14.3″N 91°13′04.3″E	3769	*Astragalus strictus*, *Pennisetum centrasiaticum*, *Geranium wilfordii* etc.	50
5	*Kobresia pygmaea* + *Potentilla anseriana*	Chabalang wetland	29°22′52.5″N 91°50′01.5″E	3588	*Kobresia pygmaea*, *Potentilla anseriana*, *Plantago asiatica* etc.	80
6	*Potentilla anseriana* + *Poa tibeticola*	Jjiangchun wetland	29°24′32.7″N 90°54′22.3″E	3597	*Potentilla anseriana*, *Poa tibeticola* etc.	85

Table 2 Soil properties in different habitats (Mean±SE). Habitat codes 1–6 correspond to the Wetlands listed in Table 1

Soil layer	Habitat code	Soil properties								
		Water content (%)	pH	Available N (g/kg)	Available P (g/kg)	Available K (g/kg)	Total N (g/kg)	Total P (g/kg)	Total K (g/kg)	Organic matter (%)
0–10 cm	1	21.389	7.555	0.162	0.010	0.049	3.011	1.586	27.045	53.884
	2	22.138	8.035	0.038	0.006	0.033	1.224	1.904	25.131	22.906
	3	13.262	8.085	0.159	0.009	0.153	4.765	1.442	25.418	45.523
	4	3.240	8.325	0.066	0.004	0.183	1.395	1.414	33.433	19.380
	5	29.023	8.175	0.066	0.004	0.072	1.485	1.389	34.758	30.363
	6	27.728	8.085	0.039	0.009	0.108	1.938	1.886	36.227	50.312
10–20 cm	1	18.592	7.700	0.099	0.005	0.038	2.250	1.474	29.647	42.867
	2	22.095	7.405	0.029	0.007	0.088	1.114	1.926	26.393	19.771
	3	11.208	8.160	0.108	0.002	0.073	2.208	1.254	27.529	46.759
	4	4.897	8.405	0.058	0.002	0.094	1.089	1.411	32.075	16.992
	5	17.970	8.385	0.048	0.002	0.047	0.958	1.333	35.456	17.548
	6	21.680	8.275	0.081	0.003	0.053	1.239	1.588	36.730	24.187
20–30 cm	1	20.085	7.855	0.085	0.004	0.034	1.904	1.494	34.352	36.995
	2	19.681	7.085	0.027	0.003	0.038	0.916	1.925	25.675	14.528
	3	16.670	8.100	0.091	0.005	0.054	3.595	1.260	23.764	72.188
	4	5.008	8.410	0.047	0.002	0.063	0.936	1.366	34.305	14.794
	5	19.912	8.385	0.047	0.003	0.048	0.903	1.361	36.657	17.040
	6	20.678	8.285	0.072	0.004	0.058	1.025	1.517	40.421	19.274

One-way ANOVA was conducted once again to determine the significance of the differences in soil microarthropod abundance (ind. m^{-2}), richness and Shannon-Wiener diversity index among habitats. LSD post-hoc tests were used to test for differences among the means. Data were transformed to natural log and square root to meet the assumption of a normal distribution and homogeneity of variance. These statistical analyses were performed using SPSS software (SPSS 18.0). Principal components analysis (PCA) was performed using CANOCO for Windows 4.5 to evaluate the effects of habitats on the composition of the soil microarthropod communities. To reduce the number of variables, an abundance of eight groups (orders or families) of soil fauna, which made up more than 95 % of the total abundance, were used to perform the statistical analyses, which included Oribatida, Isotomidae, Gamasida, Actinedida, Pseudachorutidae, Sminthuridae, Aphididae, and Aristocera larva. The similarity between different soil microarthropod communities of each habitat were determined using two similarity indexes: the Sorensen index and the Morisita–Horn index (Magurran 2004; Doblas-Miranda et al. 2007). The influence of soil available N, P, K, total N, P, K, organic matter, pH and water content on the soil microarthropod abundances were investigated by means of Canonical Correspondence Analysis (CCA) using CANOCO for Windows 4.5 (Ter Braak 1986). Abundance (log (X+1)) was transformed to ensure normality and down weight extreme values. Outliers were not excluded.

Results

Taxonomic Composition of Soil Microarthropod Communities

We collected 3356 individuals belonging to 30 taxa (Table 3). The dominant groups were Oribatida and Isotomidae, accounting for 70.46 % of the total number of individuals. The common groups included Gamasida, Actinedida, Pseudachorutidae, Sminthuridae, Aphididae and Aristocera larva, accounting for 25.48 % of the total number of individuals. The other 22 groups were rare groups, accounting for 4.05 % of the total number of individuals (Table 3).

Distribution Characteristics of Soil Microarthropods

Horizontal Distribution of Soil Microarthropod Communities

The soil microarthopod communities showed significant differences among the habitats ($P<0.05$) (Fig. 1). The habitat of *Kobresia pygmaea* + *Potentilla anseriana* had a greater abundance (54,150 ind./m^2) than the other habitats ($P<0.05$). Oribatida and Isotomidae were dominant groups in *Kobresia pygmaea* + *Potentilla anseriana*, accounting for 80.24 % of the total individuals. Gamasida, Actinedida, Psychodidae and Brachycera larva were common groups in *Kobresia pygmaea* + *Potentilla anseriana*, accounting for 17.41 % of the total

Table 3 Abundance (ind. m^{-2}) of soil microarthopods in the wetlands of the Lhasa River in the 6 habitats (Mean±SE). Habitat codes 1–6 correspond to the Wetlands listed in Table 1

Taxa	Habitats						%
	1	2	3	4	5	6	
Oribatida	350	500	425	200	34,700	1075	44.10
Isotomidae	7825	1950		100	8750	3650	26.37
Gamasida	1175	600	25	1300	4700	250	9.53
Actinedida	350	450	100	1625	2675	50	6.21
Pseudachorutidae	1700	1475	50			400	4.29
Sminthuridae	250	25		50	575	1175	2.46
Aphididae					1475	75	1.83
Aristocera larva	175	150	25	100	500	25	1.15
Chironomidae	100	25		350	250		0.86
Entomobryidae	100	25		175	325	50	0.80
Brachycera larva		275	25		25	125	0.53
Staphylinidae	225	50	25		50		0.41
Nematocera larva	175	100			25	25	0.38
Psychodidae	100	25	25		25		0.21
Curculionidae	125		25				0.18
Notodontidae larva			50			25	0.09
Chrysomelidae	25		50				0.09
Staphylinidae larva	25					25	0.06
Phlaeothripidae		25	25				0.06
Hypogastruridae	25					25	0.06
Agelenidae			25			25	0.06
Carabidae					25		0.03
Carabidae larva	25						0.03
Lucanidae						25	0.03
Noctuidae larva						25	0.03
Thomisidae					25		0.03
Forficulina					25		0.03
Cercopidae		25					0.03
Curculionidae larva						25	0.03
Silphidae						25	0.03
Total	12,750	5700	875	3900	54,150	7100	

Dominant groups (percentage of individual number>10 %), common groups (1 %<percentage of individual number<10 %), rare groups (0.1 %<percentage of individual number<1 %)

individuals. The habitat of *Kobresia pygmaea* + *Potentilla anseriana* had greater richness than *Potentilla anseriana* + *Kobresia pygmaea* and *Astragalus strictus* + *Pennisetum centrasiaticum* ($P<0.05$) (Fig. 1). The richnesses of *Potentilla anseriana* + *Kobresia pygmaea*, *Astragalus strictus* + *Pennisetum centrasiaticum* and *Kobresia pygmaea* + *Potentilla anseriana* were 13, 8, 16, respectively.

In general, distribution differences exist in the groups among the various habitats (Table 3). *Potentilla anseriana* + *Kobresia pygmaea* had no Isotomidae. Thomisidae and Forficulina were distributed only in *Kobresia pygmaea* + *Potentilla anseriana*.

Vertical Distribution of Soil Microarthropod Communities

A greater number of individuals (87.93 %) were found in the 0–10 cm soil layer. The habitat of *Kobresia pygmaea* + *Potentilla anseriana* had a higher abundance (48,450 ind./m^2) than all of the other habitats in the 0–10 cm soil layer ($P<0.05$) (Fig. 2). Isotomidae and Oribatida were the dominant groups in the 0–10 cm soil layer. However, *Potentilla anseriana* + *Kobresia pygmaea* had no Isotomidae. Phlaeothripidae and Curculionidae were distributed only in *Potentilla anseriana* + *Kobresia pygmaea*. The common was five groups at the 0–10 cm depth, i.e., Gamasida, Actinedida, Pseudachorutidae, Sminthuridae and Aristocera larva.

At the 10–20 cm depth, the habitat of *Kobresia pygmaea* + *Potentilla anseriana* had a higher abundance than *Blysmus sinocompressus* + *Deschampsia caespitosa* + *Potentilla anseriana* and *Potentilla anseriana* + *Kobresia pygmaea* ($P<0.05$) (Fig. 2). Oribatida, Actinedida and Gamasida were the most dominant groups at the 10–20 cm depth. The common was six groups at the 10–20 cm depth, i.e., Isotomidae, Sminthuridae, Aphididae, Aristocera larva, Pseudachorutidae and Entomobryidae.

At the 20–30 cm depth, the habitat of *Kobresia pygmaea* + *Potentilla anseriana* had a higher richness and Shannon-Wiener diversity index than all of the other habitats ($P<0.05$) (Fig. 2). The habitat of *Kobresia pygmaea* + *Potentilla anseriana* had the highest richness (eight) among all of the habitats. Oribatida, Aphididae, Gamasida and Actinedida were the most dominant groups at the 20–30 cm depth. The common groups were the four families, i.e., Sminthuridae, Pseudachorutidae, Isotomidae and Entomobryidae.

In general, the dominant groups increased as the soil layer deepened. Oribatida was the dominant order in three soil layers, however, Isotomidae was the only dominant family at the 0–10 cm depth.

PCA was conducted to examine the variation of the soil microarthropod community. The PC1 axis explained 56.6, 46.8 and 48.1 % of the total variation for the 0–10, 10–20 and 20–30 cm soil layers, respectively, while the PC2 axis explained 27.1, 36.0 and 24.1 % of the total variation for these three layers (Fig. 3). Isotomidae and Pseudachorutidae were the main groups associated with the separation of the PC1 axis in the 0–10 cm soil layer, Pseudachorutidae and Gamasida in the 10–20 cm and 20–30 cm soil layers. Pseudachorutidae and Oribatida were the main groups associated with the separation of the PC2 axis in the 0–10 cm soil layer, Gamasida and Sminthuridae in the 10–20 cm soil layer and Oribatida and Sminthuridae in the 20–30 cm soil layer (Fig. 3).

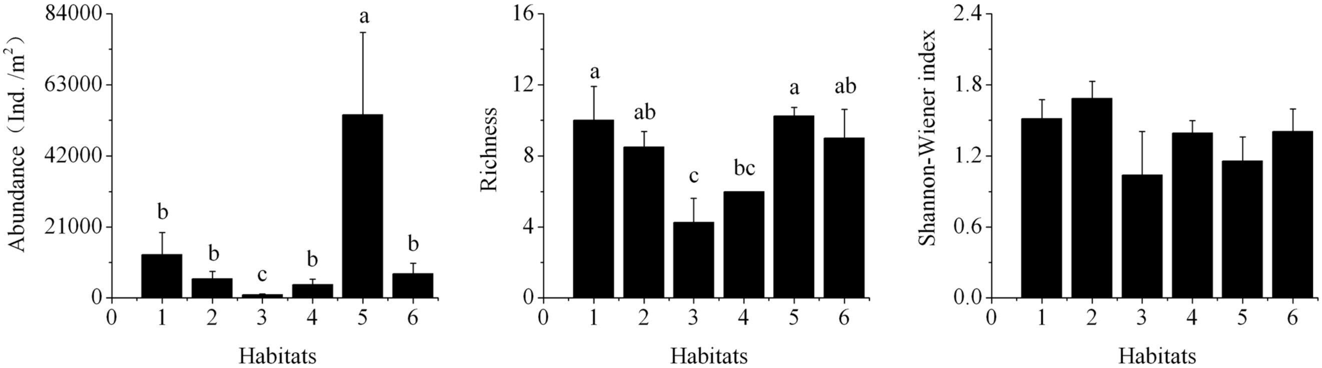

Fig. 1 Abundance, richness and Shannon-Wiener diversity index of soil microarthopods (Mean±SE). Habitat codes 1–6 correspond to the Wetlands listed in Table 1

Similarity Analysis

The Sorensen-index values of the community in *Potentilla anseriana* + *Kobresia pygmaea* was lower than all of the other habitats (range: 0.024–0.221) (Table 4), thus indicating that the taxonomic composition and abundance of the soil microarthropods in *Potentilla anseriana* + *Kobresia pygmaea* differed greatly from the other habitats. The habitat of *Potentilla anseriana* + *Kobresia pygmaea* had only two dominant orders, i.e., Oribatida and Actinedida, and no Isotomidae. Eleven common groups were found in the habitat, but there were no rare groups. The Sorensen-index value was only 0.024 between *Potentilla anseriana* + *Kobresia pygmaea* and *Kobresia pygmaea* + *Potentilla anseriana*; however, the

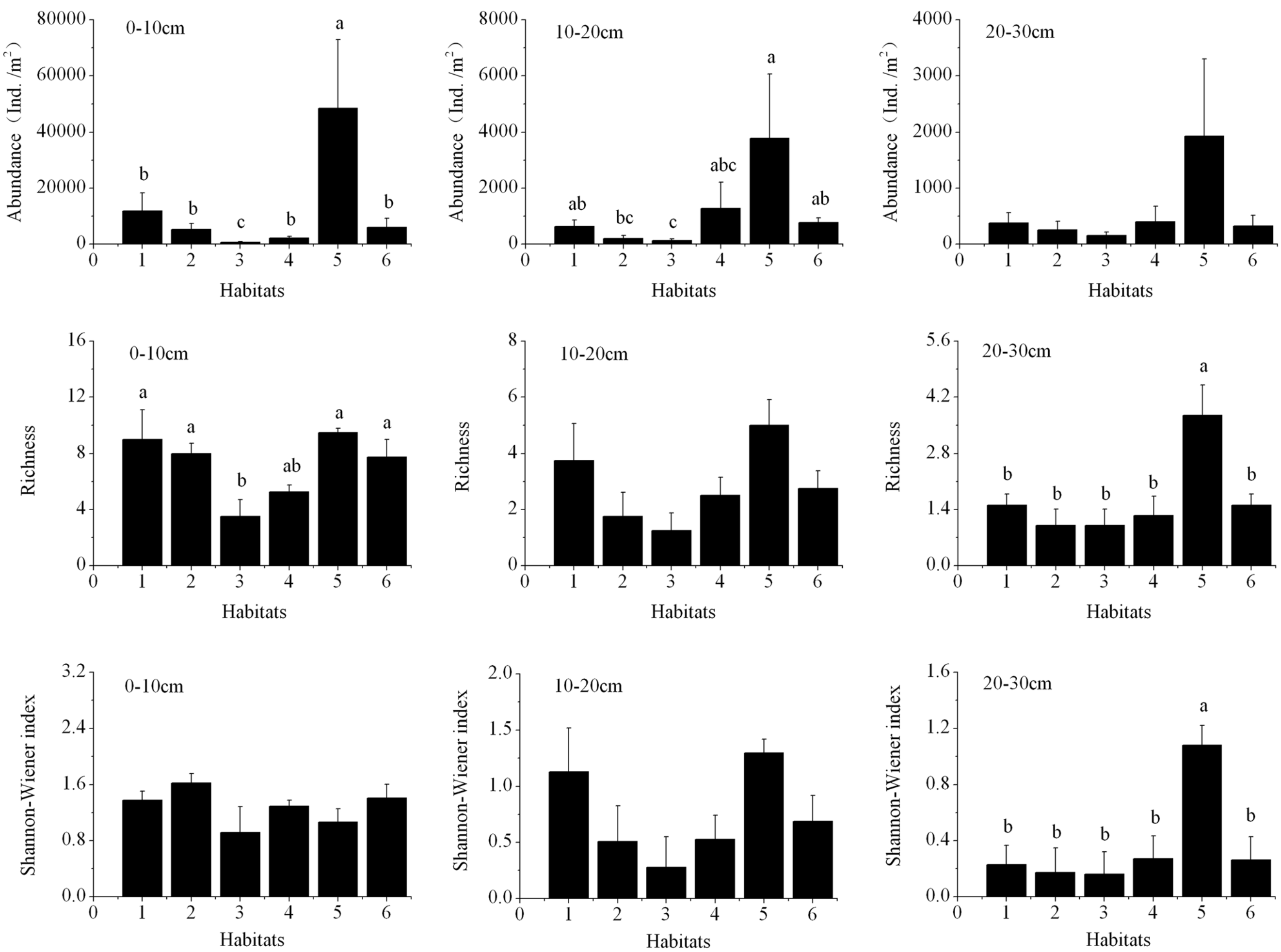

Fig. 2 Abundance, richness and Shannon-Wiener diversity index of soil microarthopods in 0–10, 10–20 and 20–30 cm soil layers (Mean±SE). Habitat codes 1–6 correspond to the Wetlands listed in Table 1

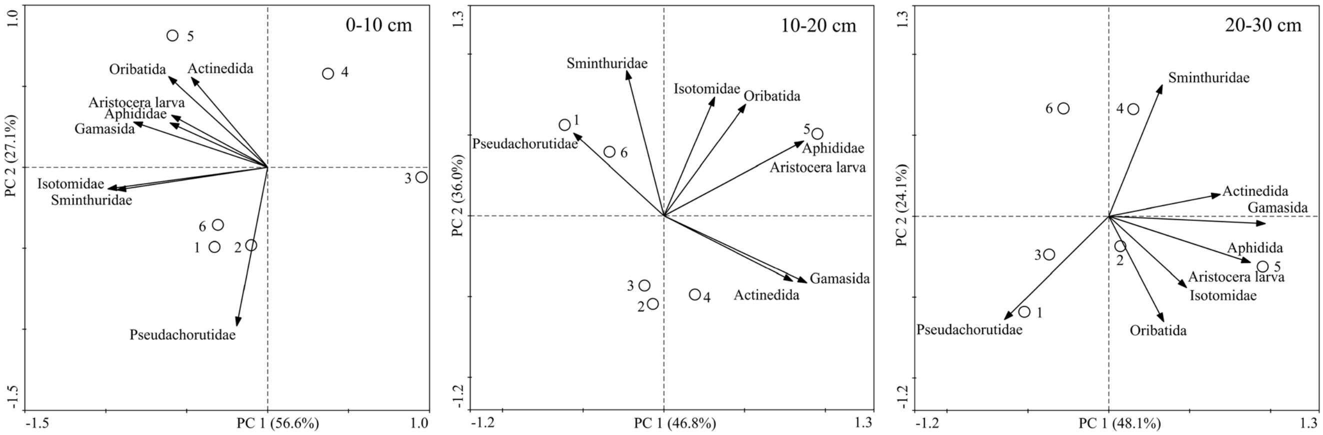

Fig. 3 Principal components analysis (PCA) results of the effects of habitats on the composition of the soil microarthropod communities. Habitat codes 1–6 correspond to the Wetlands listed in Table 1

Morisita-Horn index value in these two habitats was 0.897 (Table 4). These observations indicate that between *Potentilla anseriana* + *Kobresia pygmaea* and *Kobresia pygmaea* + *Potentilla anseriana* the dominant groups were similar, and the other groups were different. The Sorensen-index value was 0.514 between *Carex orbicularis* + *Potentilla anseriana* and *Potentilla anseriana* + *Poa tibeticola*. The Morisita-Horn index value in the two habitats was 0.921 (Table 4), indicating that the *Carex orbicularis* + *Potentilla anseriana* and *Potentilla anseriana* + *Poa tibeticola* were similar to the other habitats. Isotomidae was the dominant family in *Carex orbicularis* + *Potentilla anseriana* and *Potentilla anseriana* + *Poa tibeticola*. Gamasida, Entomobryidae, Hypogastruridae and Staphylinidae larva were same groups in these two habitats.

Relationship Between Soil Microarthopods and Soil Factor

Canonical correspondence analysis (CCA) revealed the relation between the soil microarthropod communities and the soil factor (Fig. 4). At the 0–10 cm soil depth, canonical interrelated coefficient was −0.765 between soil total K and axis 1. The soil total K reflected the soil microarthropod community in the soil layer. At the 10–20 cm soil depth, canonical interrelated coefficient was 0.647 between soil available N and axis 1. The soil available N reflected the soil microarthropod community in the soil layer. At the 20–30 cm soil depth, canonical interrelated coefficient was 0.746 between soil total N and axis 1. The soil total N content reflected the soil microarthropod community in the soil layer.

Table 4 Sorensen's index for soil microarthopod assemblage among habitats. The similarity index is calculated within each collection date, and the mean of these four values is shown here. Habitat codes 1–6 correspond to the Wetlands listed in Table 1

	1	2	3	4	5	6
1	*	0.840	0.084	0.173	0.297	0.921
2	0.556	*	0.302	0.323	0.378	0.788
3	0.095	0.221	*	0.293	0.897	0.272
4	0.261	0.318	0.147	*	0.235	0.123
5	0.312	0.129	0.024	0.131	*	0.484
6	0.514	0.527	0.163	0.132	0.189	*

Sorensen-index values are shown under the diagonal and Morisita-Horn-index values are shown above the diagonal

Discussion

Soil Microarthropods Community Composition

In our study, Oribatida and Isotomidae were shown to be the dominant groups in the wetlands of the Lhasa River. The community compositions observed in this study differed from those of the communities in the Hengduan Mountains of the Qinghai-Tibet Plateau, where Poduromorpha, Oribatida and Entomobryomorpha were the dominant groups (Wu et al. 2014). The communities found in the wetland of the Lhasa River were different from the wetland ecosystems in northeastern China, where the dominant groups were generally Acariformes, Coleoptera adult, Nemata and Stylommatophora (Wu et al. 2008). The orders and families of soil microarthropods (thirty) in the wetlands of the Lhasa River was lower than in typical wetlands on the Sanjiang Plain (thirty-two), China. Common groups have no same groups between the two study area, and Collembolla was common order in typical wetlands on the Sanjiang Plain, China.

In this study, it was shown that dominant groups increased as the soil layer deepened. Oribatida was the dominant order in three soil layers, however, Isotomidae was the only dominant family at the 0–10 cm depth. These observations indicate the community spatial variability of wetlands of the Lhasa River between different soil layers.

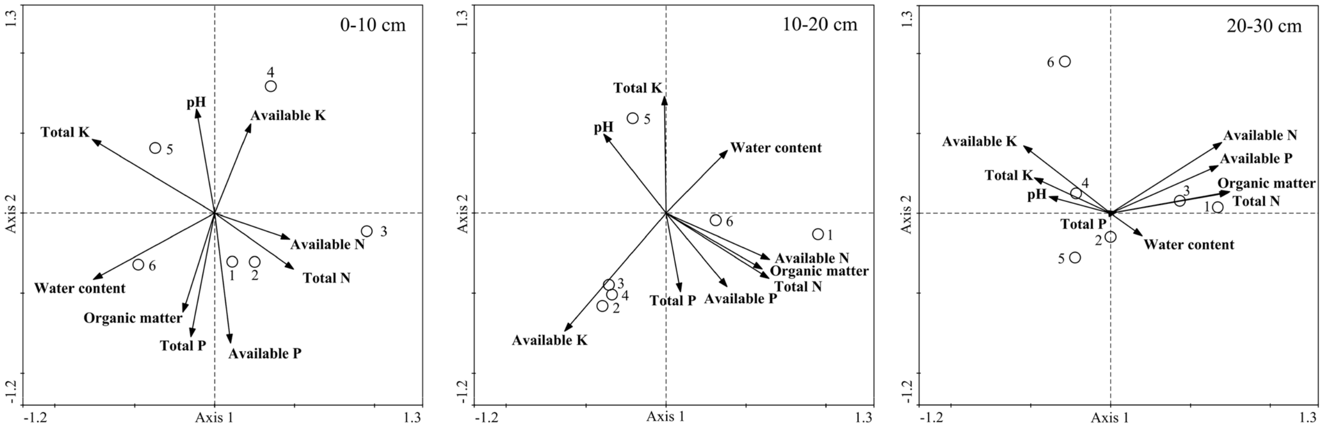

Fig. 4 Canonical correspondence analysis (CCA) results of the influence of available N, P, K, total N, P, K, organic matter, pH and water content on abundance of the soil microarthropods. Habitat codes 1–6 correspond to the Wetlands listed in Table 1

Soil Microarthropods Variability Between Habitats

In our study, the habitat of *Kobresia pygmaea* + *Potentilla anseriana* had higher abundance than all other habitats (P<0.05). The main reason for this is that the dominant order of Oribatida had a higher abundance (34,700 ind./m^2) in this habitat than all of the other habitats (P<0.05). Hector et al. (2000) reported that changes in plant diversity may affect the decomposition microenvironment. Wenninger and Inouye (2008) showed that plant community is closely related to soil microarthopods. However, the functional group of Acarina are omnivorous (Luxton 1972; Maraun et al. 2003; Schneider et al. 2004). Due to its wide range of feeding and worldwide distribution, the community composition of Oribatida does not entirely depend on the plants on the ground. In addition, *Kobresia pygmaea* are found in natural wetlands, whereas *Potentilla anseriana* is found in degraded wetlands. It can be seen that the habitat of *Kobresia pygmaea* + *Potentilla anseriana* is in a transitional period. This further confirms the fact that soil microarthopod community composition is not entirely dependent on the plants on the ground.

Soil microarthopods live in the soil, thus soil factor has a key effect on soil microarthopod diversity and distribution characteristics. In particular the weak mobile ability of soil microarthopods is easily restricted by various factors in the soil (Sun 1987; Motohiro 2001; Liu et al. 2008; Sandrine et al. 2008; Song et al. 2008). Our data showed the soil total K reflected the soil microarthropod communities at the 0–10 soil depths. The soil available N and total N reflected the soil microarthropods community at the 10–20 cm and 20–30 cm soil depth, respectively (Fig. 4). Last but not least, the elevation (3588 m) of the habitat of *Kobresia pygmaea* + *Potentilla anseriana* was lower than all of the other habitats. Due to the lowest elevation (may be highest temperature), habitat of *Kobresia pygmaea* + *Potentilla anseriana* has the highest abundance and richness, especially in the top soil layer. Previous studies have found that soil faunal individual density decreases with the rise of the elevation (Shen et al. 2005).

The habitat of *Potentilla anseriana* + *Kobresia pygmaea* had no Isotomidae (Table 2). *Potentilla anseriana* was the most dominant plant in the habitat, and *Potentilla anseriana* was found in degraded wetlands. In our study, the water contents of the 0–10, 10–20 and 20–30 cm layers in the habitat were only 13.26 %, 11.21 % and 16.67 %, respectively. Therefore, the habitat of *Potentilla anseriana* + *Kobresia pygmaea* experiences more drought than all of the other habitats. Collembola prefers shady moist environments, and has difficulty surviving in dry environments (Chen et al. 2007).

Conclusion

The soil microarthropod community composition show significantly difference among habitats in the wetlands of the Lhasa River. The soil microarthropod communities consisted of 30 taxa and 3356 individuals, and the dominant groups were Oribatida and Isotomidae. Overall, habitat of *Kobresia pygmaea* + *Potentilla anseriana* had a higher abundance than all of the other habitats (P<0.05). A greater number of individuals (87.93 %) were found in the 0–10 cm soil layer. Habitat of *Kobresia pygmaea* + *Potentilla anseriana* showed a significantly higher abundance than all of the other habitats at the 0–10 depth, and richness and Shannon-Wiener diversity index than all of the other habitats at 20–30 cm depth (P<0.05). Dominant groups increased as the soil layer deepened. Oribatida was the dominant order in three soil layers, however, Isotomidae was the only dominant family at the 0–10 cm depth. The soil microarthopod communities was significantly correlated with total K content in the 0–10 soil layers. However, the soil microarthopod communities was significantly correlated with the soil available N content in 10–20 cm soil layer, soil total N content in the 20–30 cm soil layer. Compared to other geographical locations in China, soil microarthopod communities exhibit unique zonal patterns in the wetlands of the Lhasa River.

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