COMPOSITION AND BIODIVERSITY OF COLLEMBOLA IN CAN THO CITY

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ABSTRACT

Collembola communities in Can Tho city were investigated on species composition, distribution and biodiversity in 27 sampling stations. The study recorded 60 species belonging to 34 genera under 12 families. They were characterized by high dominance index and occurrence constancy index. The findings also showed Collembola differently distributed according to natural habitats and seasons. These results indicated Collembola communities are useful soil fauna for bioindicator, soil quality and environmental monitoring.

Keywords: species composition, biodiversity, Collembola, Can Tho city.

TÓM TẮT

Đa dạng sinh học và thành phần loài bọ nhảy ở thành phố Cần Thơ

Quần xã bọ nhảy tại thành phố Cần Thơ được nghiên cứu về thành phần loài, sự phân bố và đa dạng sinh học tại 27 điểm thu mẫu. Nghiên cứu ghi nhận 60 loài thuộc 34 giống 12 họ. Quần xã bọ nhảy được đặc trưng bởi chỉ số ưu thế và độ thường gặp. Kết quả nghiên cứu còn cho thấy bọ nhảy phân bố khác nhau theo mùa và sinh cảnh tự nhiên. Quần xã bọ nhảy là nhóm động vật đất hữu ích cho chỉ thị sinh học, chất lượng đất và quan trắc môi trường đất.

Từ khóa: thành phần loài, đa dạng sinh học, bọ nhảy, thành phố Cần Thơ.

1. Introduction

Recently, using bio-methodology for evaluation of soil quality has been concerned and applied in many countries. In activities of soil monitoring and management, soil quality assessment through bio-methodology could overcome such limitations of other methods which require expensive chemical and equipment. Striking mecrits of biological method will provide data with low fee, simple ways and friendly to environment.

Collembola is one of soil fauna which has high and diverse level of species composition in land ecosystem. They break down organic detritus and participate actively in the process of soil mineralization and fertility. They play an crucial role in the soil food web and considered as the link of an important chain to make energy metabolism and material transportation in order to balance ecological system [1]. They are further known being useful indicators of habitat and soil quality because they are

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influenced by multiple and synergistic impacts of different pollutants, and sensitive to both chemical and physical effects on their habitat. However, there is little literature about Collembola communities in Mekong Delta in general and Can Tho city in particular.

There were only two previous studies on Collembola communities in Can Tho city. Truong Hoang Dan (2005) [6] who observed the population and component of Collembola in different cultivation conditions of perennial orchard found that non-using chemical orchards showed a richness of Collembola fauna than intensive orchards. Meanwhile, Nguyen Anh Tam (2010) [3] reported intensive watermelon gardens had a low value of biodiversity index and Collembola and Lumbricimopha were two sensitive species to agrochemistry.

In Mekong Delta, Can Tho city is the largest city which is the main center of transportation, culture and economy for region. However, population growth, rapid urbanization process, wider application of pesticide for intensive agriculture and environmental pollution have led to ecosystem changes, depletion of biodiversity, particularly Collembola communities. Hence, investigation on abundant composition of Collembola is not only essential for process of soil mineralization but also for indication of soil quality. This study focuses on identify species composition, densities and biodiversity of Collembola communities. It also aims to provide a baseline data of Collembola communities for further research on bioindicator, soil quality and environmental monitoring.

2. Materials and methods

2.1. Sampling stations

The sampling collection was carried out from November 2013 to May 2014 with two periods of collection. Each period took place in one month. From land use map of Can Tho city, 27 sampling stations were selected with area 1km x 1km = 1km^2 (Figure 1). At each sampling station, five habitats including paddy field and milpa (H1), perennial orchard land (H2), housing and roadside land (H3), garden housing (H4), and inactive agricultural land (H5) were identified and then ten samples at every habitat were collected in rainy and sunny seasons.

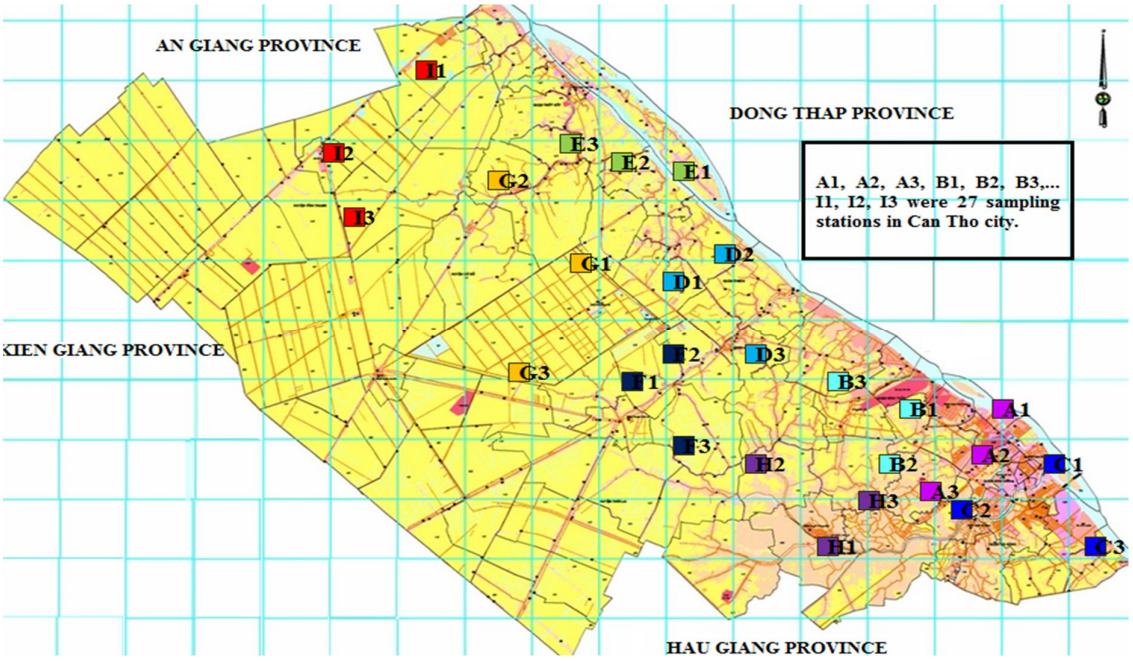

Figure 1. *Sampling stations of Collembola communities in Can Tho city, Vietnam*

2.2. Data collection and analysis

Methods of pitfall trap, shelter trap, suction sample and soil core were used for Collembola collection following methods from Nguyen Tri Tien (1995) [4] and Truong Hoang Dan (2005) [6]. All specimens were washed with KOH 10% before fixing with Svan solution contained 20ml of distilled water, 60 gram of chloral hydrate, 15gram of gum arabic, 3 gram of glucose, and 20 ml of acetic acid Truong Hoang Dan (2005) [6].

All specimens were counted and identified based on description documentaries of Fjellberg (1980) [1], Gisin (1960) [2], Nguyen Tri Tien (1995) [4] and Stach (1965) [5].

The species dominance classes were calculated based on Vogel et al (2012) [7], D% = (i/t) × 100, where i = total number of individuals of a species, and t = total of sampled individuals. Occurrence constancy was found with the index C = p × 100/N according to Vogel et al (2012) [7], where p is the number of surveys containing the analysed species and N the total number of surveys.

3. Results and discussion

3.1. Species composition of Collembola communities

Total of 60 species were identified to 34 genera belonging to 12 families in this survey. The results also showed that 13 species belonging to seven families had a wide range of distribution and appeared in both sunny and rainy seasons. They were *Xenylla humicola* (Family Hypogastruridae), *Pseudachorutella asigillata* (Family Neanuridae); *Folsomides exiquus, Poisotoma submusciola* (Family Isotomidae); *Entomobrya*

lanuginose, Sinella pseudomonoculata, Sinellla coeca, Homodia socra, Pseudosinella octopunctata (Family Entomobryidae); *Cyphoderus javanus* (Family Cyphoderidae)*; Megalothorax minimus* (Family Neelidae); *Sminthurides aquaticus, Sminthurides bothrium* (Family Sminthurididae) (Table 1).

Table 1. *List of Collembola communities was recorded in Can Tho city, Vietnam*

No	Species composition	Rainy season (∗), Sunny season (•)				
		H 1	H 2	H 3	H 4	H 5
I	**Family Hypogastruridae Borner, 1906**					
	Genus *Acherontiellina* Salmon, 1964					
1	*Acherontiellina Sabina* Bornet, 1945	(•)	(∗),(•)		(∗),(•)	(∗),(•)
	Genus *Ceratophysella* Borner, 1932					
2	*Ceratophysella denticulata* (Bagnall, 1941)		(∗),(•)		(∗),(•)	(•)
3	*Ceratophysella paralagulidersa* Nguyen, 2001		(•)		(•)	
	Genus *Xenylla* Tullberg, 1869					
4	*Xenylla humicola* (Fabricius, 1780)	(∗),(•)	(∗),(•)	(∗),(•)	(∗),(•)	(∗),(•)
II	**Family Onychiuridae Boner, 1903**					
	Genus *Onychiurus* Gervais, 1841					
5	*Onychiurus saphianus* Nguyen, 2001	(•)	(•)	(•)	(•)	(∗)
	Genus *Protaphorura* Absolon, 1901					
6	*Protaphorura hortensis* (Gisin, 1949)	(•)	(•)		(•)	(∗),(•)
	Genus *Tullbergia* Lie-Petersen,1897					
7	*Tullbergia* sp.1	(∗),(•)	(∗),(•)	(∗),(•)		(•)
	Genus *Mesaphorura* Borner, 1901					
8	*Mesaphorura krausbaueri* Borner, 1901		(∗)		(∗)	(∗)
III	**Family Neanuridae Casagnau, 1955**					
	Genus Friesea von Dalla Torre, 1895					
9	*Friesea sublimis* Macnamara, 1921		(•)	(•)		(∗),(•)
	Genus *Pseudachorutella* Stach, 1949					
10	*Pseudachorutella asigillata* (Borner, 1901)	(∗),(•)	(∗),(•)	(∗),(•)	(∗),(•)	(∗),(•)
	Genus *Anurida* Laboulbene, 1865					
11	*Anurida* sp.1	(∗),(•)	(∗),(•)			(∗),(•)
	Genus *Vitronura* Yosii, 1963					
12	*Vitronura giselae* (Gisin, 1950)		(•)		(•)	(∗),(•)

	Genus *Lobellina* Yosii, 1956					
13	*Lobellina* sp.1					(•)
	Genus *Paralobella* Cassagnau & Deharveng, 1984					
14	*Paralobella* sp.1			(∗),(•)	(•)	(•)
15	*Paralobella* sp.2	(∗)	(∗)		(∗)	
	Genus *Propeanura* Yosii, 1956					
16	*Propeanura* sp.1		(∗),(•)	(•)	(∗),(•)	
IV	**Family Isotomidae Borner, 1913**					
	Genus *Folsomides* Stach, 1922					
17	*Folsomides amercanus* Denis, 1931	(∗)	(∗)		(∗)	
18	*Folsomides exiquus* Folsom, 1932	(∗),(•)	(∗),(•)	(∗),(•)	(∗),(•)	(∗),(•)
	Genus *Proisotoma* Borner, 1901					
19	*Proisotoma submusciola* Nguyen, 1995	(∗),(•)	(∗),(•)	(∗),(•)	(∗),(•)	(∗),(•)
	Genus *Folsomina* Denis, 1931					
20	*Folsomina Onychiurina* Denis, 1931		(•)		(•)	(∗),(•)
	Genus *Isotomiella* Bagnall, 1939					
21	*Isotomiella minor* (Schaffer, 1896)	(∗),(•)			(∗)	(∗),(•)
	Genus *Isotomurus* Borner, 1913					
22	*Isotomurus padustris* (Müller, 1776)	(∗),(•)				(∗),(•)
23	*Isotomurus punctiferus* Yosii, 1963	(∗),(•)	(∗),(•)			(∗),(•)
V	**Family Entomobryidae Schott, 1891**					
	Genus *Entomobrya* Rondani, 1861					
24	*Entomobrya lanuginose* (Nicolet, 1841)	(∗),(•)	(∗),(•)	(∗),(•)	(∗),(•)	(∗),(•)
25	*Entomobrya muscorum* (Nicolet, 1841)	(∗)		(∗)		(∗)
26	*Entomobrya* sp.1	(∗)	(∗)	(∗)	(∗)	(∗),(•)
	Genus *Seira* Lubbock, 1869					
27	*Seira oligomacrochaeta* Nguyen, 2001			(∗),(•)		(∗),(•)
	Genus *Sinella* Brook, 1883					
28	*Sinella pseudomonoculata* Nguyen, 1995	(∗),(•)	(∗),(•)	(∗),(•)	(∗),(•)	(∗),(•)
29	*Sinellla coeca* (Schoot, 1896)	(∗),(•)	(∗),(•)	(∗),(•)	(∗),(•)	(∗),(•)
	Genus *Homodia* Borner, 1906					
30	*Homodia glassa* Nguyen, 2001					(∗),(•)

31	*Homodia socia* Denis, 1929	(∗),(●)	(∗),(●)	(∗),(●)	(∗),(●)	(∗),(●)
32	*Homodia subsingula* Denis, 1948		(●)		(●)	(∗),(●)
	Genus *Pseudosinella* Schaffer, 1897					
33	*Pseudosinella octopunctata* Borner, 1901	(∗),(●)	(∗),(●)	(∗),(●)	(∗),(●)	(∗),(●)
34	*Pseudosinella fujiokai* Yosii, 1964		(●)		(∗),(●)	(∗),(●)
35	*Pseudosinella immaculate* (Lie-petterson, 1897)		(∗),(●)	(∗),(●)	(∗),(●)	
	Genus *Lepidocyrtus* Bourlet, 1839					
36	*Lepidocyrtus cyaneus* Tullberg, 1871		(∗)	(∗)	(∗)	(∗)
37	*Lepidocyrtus ruber* Schoot, 1902		(∗),(●)			(●)
38	*Lepidocyrtus filamentosus* Yosii, 1982	(●)	(∗),(●)	(∗),(●)	(●)	
39	*Lepidocyrtus aseanus Yosii*, 1982		(●)			(∗),(●)
40	*Lepidocyrtus concolourus* Nguyen, 2001	(∗)	(∗)	(∗)	(∗)	(∗)
41	*Lepidocyrtus dahlia* Schaffer, 1898	(●)	(●)	(●)	(●)	(●)
42	*Lepidocyrtus heterolepis* Yosii, 1959			(∗),(●)		(∗)
43	*Lepidocyrtus vietnamesis* Yosii, 1982		(●)		(●)	
44	*Lepidocyrtus segamanus* Yosii, 1982		(∗),(●)			(∗),(●)
	Genus *Dicranocentrus* Bonet, 1930					
45	*Dicranocentrus indicus* Bonet, 1930	(∗),(●)		(∗),(●)	(∗),(●)	
VI	**Family Cyphoderidae Borner, 1913**					
	Genus *Cyphoderus* Nocolet, 1842					
46	*Cyphoderus javanus* Borner, 1906	(∗),(●)	(∗),(●)	(∗),(●)	(∗),(●)	(∗),(●)
VII	**Family Paranellidae Borner, 1906**					
	Genus *Salina* Macgilliery, 1894					
47	*Salina celebensis* (Schaffer, 1898)		(●)			(∗)
VIII	**Family Neelidae Folsom, 1896**					
	Genus *Megalothorax* Willem, 1900					
48	*Megalothorax minimus* Willem, 1900	(∗),(●)	(∗),(●)	(∗),(●)	(∗),(●)	(∗),(●)
IX	**Family Sminthurididae Borner, 1906**					
	Genus *Sminthurides* Borner, 1900					
49	*Sminthurides aquaticus* (Bourlet, 1842)	(∗),(●)	(∗),(●)	(∗),(●)	(∗),(●)	(∗),(●)
50	*Sminthurides bothrium* Nguyen, 2001	(∗),(●)	(∗),(●)	(∗),(●)	(∗),(●)	(∗),(●)
51	*Sminthurides parvulus* (Krausbauer, 1898)			(●)		(●)

52	*Sminthurides pseudassimilis* Stach, 1956	(•)	(•)	(•)	(•)	
	Genus *Sphaeridia* Linnanniemi, 1912					
53	*Sphaeridia zaheri* Yosii, 1966	(*)	(*),(•)	(*),(•)	(*),(•)	(*),(•)
54	*Sphaeridia pumilis* (Krausbauer, 1898)		(•)		(•)	(*),(•)
X	**Family Sminthuridae Borner, 1913**					
	Genus *Sphyrotheca* Borner, 1906					
55	*Sphyrotheca boneti* (Denis, 1948)					(*)
56	*Sphyrotheca macrochaeta* Nguyen, 1995		(*),(•)		(*),(•)	(*),(•)
57	*Sphyrotheca nepalica* Yosii, 1966	(*),(•)	(*),(•)			(*),(•)
XI	**Family Dicyrtomidae Borner, 1903**					
	Genus *Calvatomina* Yosii, 1966					
58	*Calvatomina antenna* (Nguyen, 1995)		(*)		(*)	(*)
59	C*alvatomina tuberculata* (Nguyen, 2001)			(*)	(*)	(*)
XII	**Family Bourletiellidae Banks, 1899**					
	Genus *Deuterosminthurus* Borner, 1901					
60	*Deuterosminthurus* sp.1	(•)	(•)	(*)	(•)	(*),(•)

There were rare species that appeared solely either one habitat or season, for example *Homodia glassa* (Family Entomobryidae) and *Lobellina* sp.1 (Family Neennuridae). These species such as *Mesaphorura krausbaueri* (Family Onychiuridae)*; Folsomides amercanus (*Family Isotomidae); *Lepidocyrtus cyaneus, Lepidocyrtus concolourus* (Family Entomobryidae); *Sphyrotheca boneti* (Family Sminthuridae); *Calvatomina antenna, Calvatomina tuberculata* (Family Dicyrtomidae) were recorded only in in rainy season. Meanwhile, *Ceratophysella paralagulidersa* (Family Hypogastruridae); *Paralobella sp.2* (Family Neennuridae); *Lepidocyrtus dahlia, Lepidocyrtus vietnamesis* (Family Entomobryidae); *Sminthurides pseudassimilis* (Family Sminthurididae) were found in sunny season (Table 1).

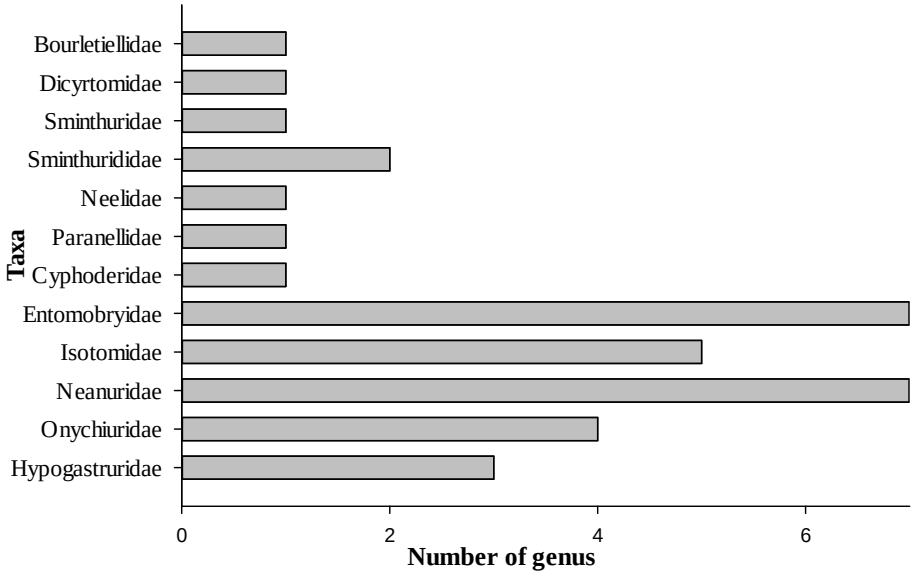

Figure 2. *Number of Collembola genus per family*

Table 2. *Number and percentage of Collembola speciess per family*

No	Taxa	Number of species	Percentage
1	Hypogastruridae	4	6,67
2	Onychiuridae	4	6,67
3	Neanuridae	8	13,33
4	Isotomidae	7	11,67
5	Entomobryidae	22	36,67
6	Cyphoderidae	1	1,67
7	Paranellidae	1	1,67
8	Neelidae	1	1,67
9	Sminthurididae	6	10,00
10	Sminthuridae	3	5,00
11	Dicyrtomidae	2	3,33
12	Bourletiellidae	1	1,67
Total		**60**	**100**

Family Entomobryidae was great variety with 22 species. They also presented highest number of genera which were *Entomobrya* Rondani, *Seira* Lubbock, *Sinella* Brook, *Homodia* Borner, *Pseudosinella* Schaffer, *Lepidocyrtus* Bourlet, and *Dicranocentrus* Bonet. Neanuridae, the second family with 8 species were recorded although the genus of this family was equal to family Entomobryidae. There were seven species belonging to five genera were found in family Isotomidae which followed by family Entomobryidae and Neanuridae. Meanwhile four families Cyphoderidae, Paronellidae, Neelidae and Bourletiellidae had one species and one genus. They should be considered for conservation (Table 2 and Figure 2).

3.2. Distribution of Collembola communities according to habitats and season

The number of Collembola species differently distributed according to habitats and seasons. In all habitats, sunny season had the number of Collembola species higher than rainy season except for the habitat, inactive agricultural land. However, in inactive agricultural land total Collembola species of two seasons was highest among five habitats. Noticeably, there were three species of Collembola communities (*Sphyrotheca boneti, Homodia glassia, Lobellina sp*.1) only detecting in habitat, inactive agricultural land. Collembola communities had more species and distribution in habitat, inactive agricultural land compared to other habitats because this habitat had little effect from human activities. Moreover high organic matter, humidity and vegetation covered could be other explanation for highest diversity of Collembola in habitat, inactive agricultural land (Figure 3).

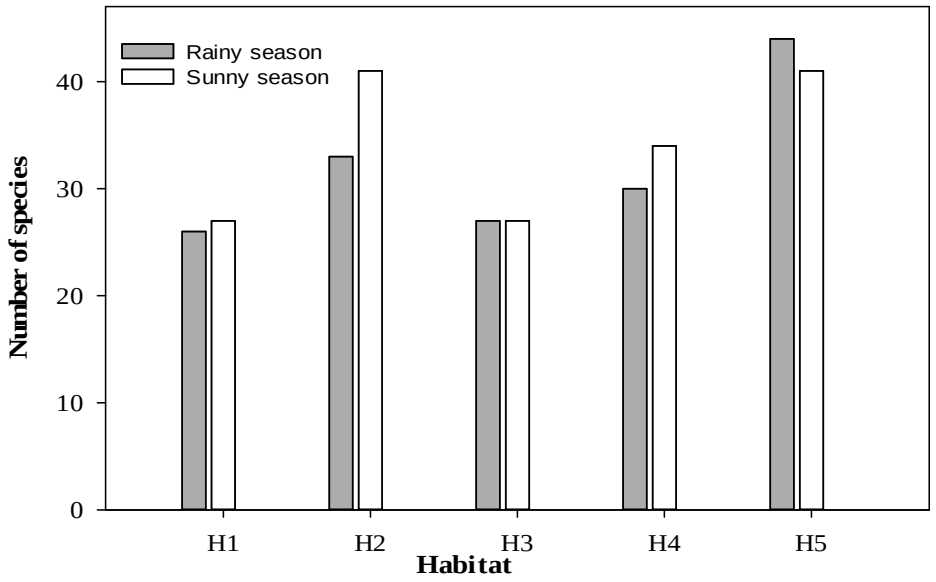

Figure 3. *Distribution of Collembola communities according to habitats and season*

Collembola communities had less distribution in two habitats, paddy field and milpa, and housing and roadside land. These habitats were affected from human activities such as agrochemical of cultivation, transportation, construction which led to negative impacts on Collembola communities. In comparison to previous study, the distribution of Collembola communities in perennial orchard land and garden housing was similar to findings of Truong Hoang Dan (2005) [6] who investigated the population and component of main soil fauna in different cultivation conditions of mango orchards (Figure 3).

3.3. Biodiversity of Collembola communities

Table 3. *Dominance index of Collembola species in Can Tho city*

No	Species	Dominance index (D) of five habitats				
		H1	**H2**	**H3**	**H4**	**H5**
1	*Onychiurus saphianus*		5,15	7,85		16,75
2	*Proisotoma submusciola*	15,5	9,8	10,35	12,35	
3	*Isotomurus punctiferus*	7,5	10,9			9,75
4	*Homodia socia*	12,7	14,5	9,84	15,5	15,2
5	*Pseudosinella octopunctata*	9,65		12,75		20,20
6	*Lepidocyrtus concolourus*	14,45	9,85	10,65	12,70	
7	*Dicranocentrus indicus*		13,35			9,78
8	*Cyphoderus javanus*	14,90			10,25	
9	*Sminthurides aquaticus*	17,80		13,78		8,79
10	*Sphaderidia zaheri*		8,94		9,45	9,78
11	*Isotominella minor*	10,7				

According to Vogel et al (2012) [7], species consider as dominants when species dominance index (D) constitute 5% or more. In this study, 11 Collembola species had dominance index higher than 5% including one species dominated in all habitats, two species dominated in four habitats, five species dominated in three habitats, two species five species dominated in two habitats, and one species dominated in one habitat. *Homidia socia* was dominant species in five habitats whereas *Isotominella* solely dominated in habitat paddy field and milpa (Table 3).

Table 4. *Occurrence constancy index of Collembola species in Can Tho city*

No	Species	Occurrence constancy index (C) of five habitats				
		H1	H2	H3	H4	H5
1	*Homodia socia*	55	65		75	70
2	*Onychiurus saphianus*		50	60		65
3	*Proisotoma submusciola*		50	60	65	
4	*Isotomurus punctiferus*	50	60			55
5	*Lepidocyrtus concolourus*	75			65	
6	*Sminthurides aquaticus*	78		65		
7	*Sphaderidia zaheri*		50		55	

Occurrence constancy index (C) proposed category constant species when C = > 50% [7]. The study recorded seven constant species in research area with *Homodia socia* was the constant species in four habitats, three species (*Onychiurus saphianus, Proisotoma submusciola, Isotomurus punctiferus)* were constant in three habitats and others *Lepidocyrtus concolourus, Sminthurides aquaticus, Sphaderidia zaheri)* were constant species in two habitats (Table 4).

4. Conclusion

Collembola communities in Can Tho city was characterized high biodiversity. 60 species were identified to 34 genera belonging to 12 families. In which, many dominant and constant species were recorded to widely distribute in almost sampling stations. They are useful for bioindicator, soil quality and environmental monitoring.

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