

Rotifer Communities in the Cambodian Mekong River Basins

ชุมชนโรติเฟอร์ในลุ่มแม่น้ำโขงของประเทศกัมพูชา

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ABSTRACT

Species of rotifers in 5 provinces (Kampong Cham, Kampong Chhnang, Kandal, Prey Veng and Takeo Provinces) of Cambodia were studied. Rotifers were collected during rainy season (16–19 October 2006) from 80 sampled localities ranging from canals, flooding areas, lakes, ponds, rice fields and swamps using a 60 μ m mesh plankton net. Water temperature, electro conductivity, pH, latitude, longitude and altitude were measured at each sampled locality. Specimens were immediately preserved in 5% formalin and then examined under a compound microscope. One hundred and twenty eight species belonging to 30 genera were found, 125 of which are new records for Cambodia. The common species were *Polyarthra vulgaris* (91.2% of the sampled localities), followed by *Lecane bulla* (88%), *L. leontina* (85%), *Plationus patulus* (75%), *L. unguitata* (73.7%), and *Testudinella patina* (71.2%). The highest species diversity was found in Chorchork swamp of Prey Veng Province with 51 species.

บทคัดย่อ

ศึกษาความหลากหลายชนิดของโรติเฟอร์ใน 5 จังหวัดของประเทศกัมพูชา ได้แก่ กำปงจาม กอมปงฉั่น กอลดาล ไปรเวง และตาแก้ว ทำการเก็บตัวอย่างในทะเลสาบ คลอง พื้นที่ชุ่มน้ำ บ่อน้ำ นาข้าว และหนองน้ำ ในช่วงฤดูฝนระหว่างวันที่ 16–19 ตุลาคม 2549 จำนวน 80 ตัวอย่าง โดยใช้ถุงลากแพลงก์ตอนขนาดตา 60 ไมครอนเมตร เก็บรักษาตัวอย่างด้วยฟอร์มาลินความเข้มข้น 5% พร้อมทั้งตรวจวัดคุณภาพน้ำบางประการ ได้แก่ พีเอช อุณหภูมิ ค่าการนำไฟฟ้า ละติจูด ลองจิจูด และความสูงจากระดับน้ำทะเล ตรวจวิเคราะห์ตัวอย่างภายใต้กล้องจุลทรรศน์แบบใช้แสง พบโรติเฟอร์ 30 สกุล 128 สปีชีส์ เป็นชนิดที่พบครั้งแรกในประเทศกัมพูชาจำนวน 125 สปีชีส์ ชนิดที่พบบ่อย ได้แก่ *Polyarthra vulgaris* (ร้อยละ 91.2 ของตัวอย่างทั้งหมด) *Lecane bulla* (ร้อยละ 88.0) *L. leontina* (ร้อยละ 85.0) *Plationus patulus* (ร้อยละ 75.0) *L. unguitata* (ร้อยละ 73.7) และ *Testudinella patina* (ร้อยละ 71.2) แหล่งน้ำที่มีความหลากหลายชนิดของโรติเฟอร์มากที่สุด ได้แก่ หนองน้ำในหมู่บ้านจ้อจอก จังหวัดไพรเวง พบโรติเฟอร์ 51 สปีชีส์

Key Words: Rotifera, Mekong river, Diversity, Cambodia

คำสำคัญ : โรติเฟอร่า แม่น้ำโขง ความหลากหลาย กัมพูชา

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Introduction

Cambodia is a tropical with monsoonal climatic country in Southeastern Asia, bordering the Gulf of Thailand, between Thailand, Vietnam, and Laos. Its approximate geographical coordinates are 13° N 105° E. Rotifers fauna in Cambodia was first study by Berzins 1973. Four species belong to 4 genera which 1 new species of *Lecane blachei*, 1 new genus and new species of *Anchitestudinella mekongensis*, 1 new subspecies of *Filinia camase-cla* and the other one is *Brachionus donnei* Brehm from Mekong-system in the environment of Phnom Penh were described. Cause of a lot freshwater habitats variety occur in Cambodia (canals, flooding areas, lakes, ponds, rice fields, streams, swamps, and rivers), it should be many more species than currently recorded maybe present. The purpose of this paper is to report on rotifers fauna in the 80 habitats of Cambodian Mekong River Basins.

Study Area

Study area was focuses on 5 provinces of Cambodian Mekong River basins in Cambodia (Fig. 1). Three of them (Kampong Cham, Kandal, Prey Veng Provinces) are flowed across by Mekong River and the other 2 are situated by 1 Tonle Sap great lake (Kampong Chhnang Province) and 1 big lake of lake of Tonle Bati lake (Takeo Province). There are four main rivers (Basac, Mekong, Chatomuk, Tonle Sap River) and one great lake (Tonle Sap Lake) in Cambodia. One of the most biggest river is Mekong River that flows across 5 Provinces; Steung Treng and Kratie Province (upper part), Kampong Cham Province (Eastern part), Kandal Province (join together with Basac

and Tonle Sap River situate in Phnom Penh call Chatomuk River), Prey Veng Province (Southeastern part). Takeo Province is in the South part of Cambodia which obtain one big lake (Tonle Bati Lake), bordering with Kandal Province. Tonle Sap great Lake is a shallow lake in western Cambodia which is part of the Mekong River system. It is the largest lake of Southeast Asia and is fed by numerous streams. During the dry season it drains by the Tônlé Sap River southeast to the Mekong River. During the wet monsoon season of June to November, the high waters of the Mekong River reverse the flow of the Tonle Sap River and increase the size of the lake. When the high waters of the Mekong River recede, the flow reverses. This natural mechanism provides a unique and important balance to the Mekong River down stream of the lake and ensures a flow of fresh water during the dry season into the Mekong delta in Vietnam which buffers the intrusion of salt water from the South China Sea into the rich agricultural lands of the delta. The samples for this study were collected from 80 habitats of freshwater, ranging from canals, flooding areas, lakes, ponds, rice fields, swamps, and streams to rivers.

Material and Methods

Samples were collected quantitatively by using 60 µm mesh net during 16–19 October 2006. The animals were preserved in 5% formalin. Water temperature, electro conductivity, pH and altitude of samples were measured at each sampled localities (table 1).

Specimens of rotifers were identified to species under compound microscope depending

on key books. Scanning electron microscope was used for checking (take photo) trophi and lorica of some species of rotifers by following methods of Sanoamuang & McKenzie (1993) and Sanoamuang & Stout (1993) (Figs. 3 and 4). Photo of rotifers

were taken by Olympus SZX-ILLK 200 compound microscope.

The correlation between species richness and some environmental variable were analyzed by SPSS Program version 13.

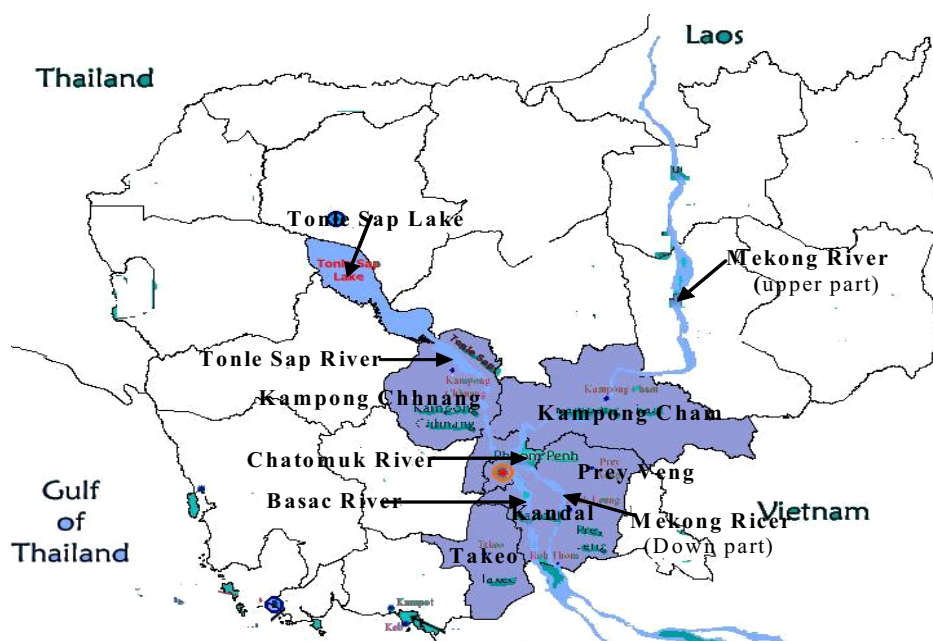


Figure 1 Map of Cambodia showing 5 provinces where the rotifer samples were collected

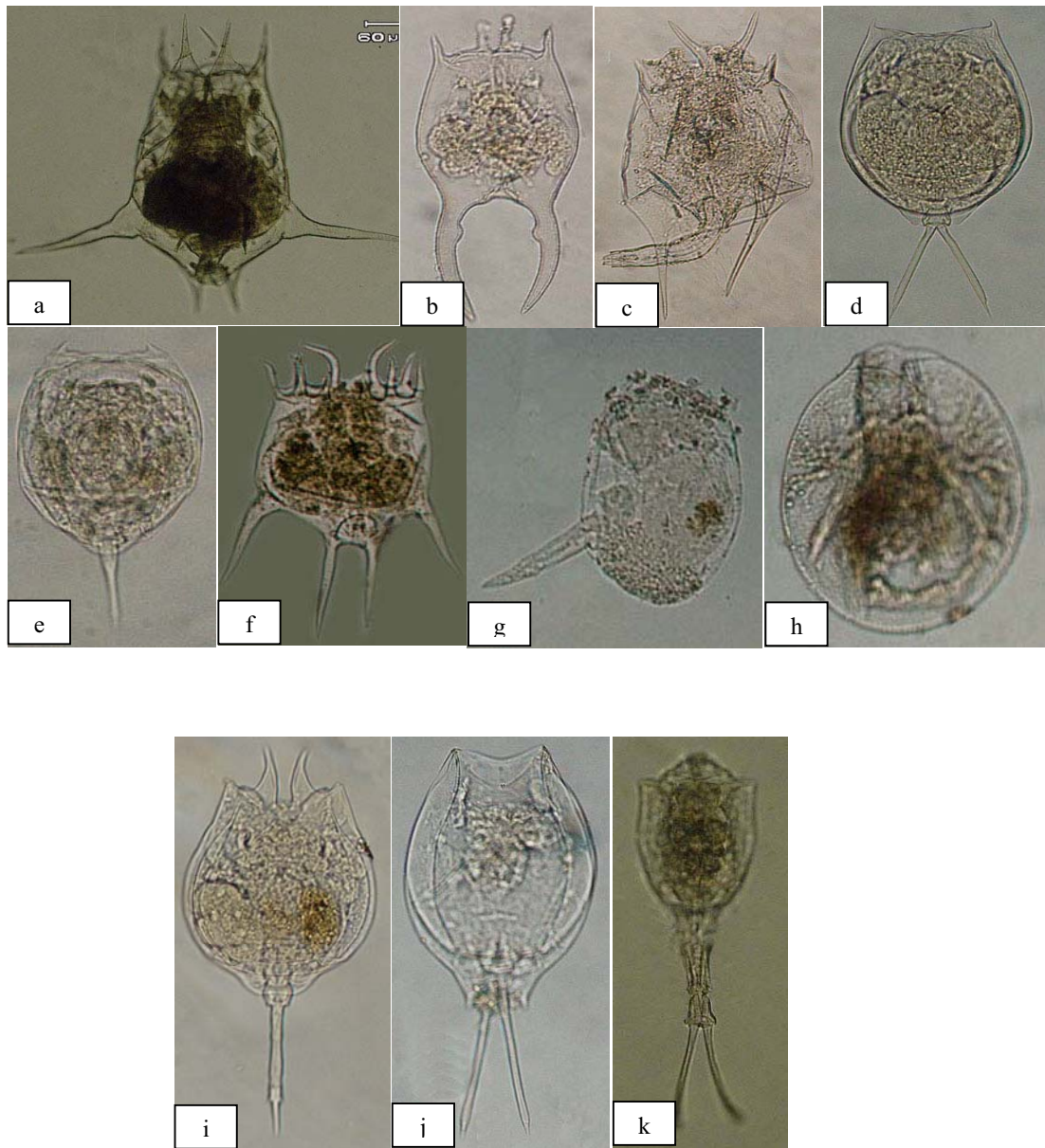
Table 1 Some ecological variables measured from the sampled localities.

Level	Electro cond. ($\mu\text{S cm}^{-1}$)	pH	Temp. ($^{\circ}\text{C}$)
Maximum	427	8.1	35.8
Average	83.1	6.8	31
Minimum	22.7	5.8	19.7
Range	22.7–427	5.8–8.1	19.7–35.8

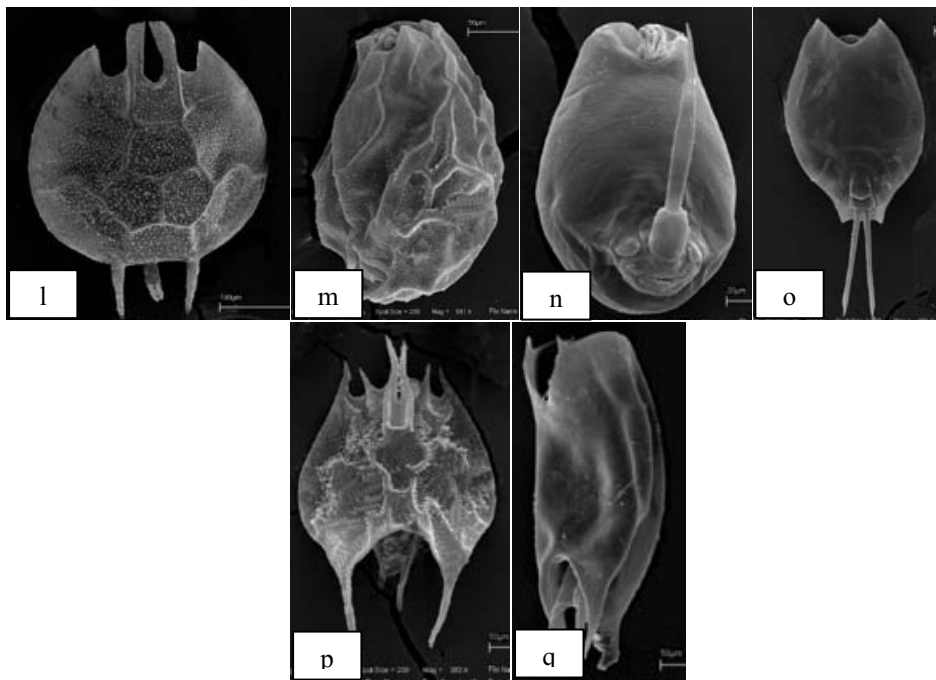
Results and Discussions

One hundred and twenty eight species belong to 30 genera of rotifers were investigated from 80 sampled localities of Cambodian Mekong River Basins (table 2). Three species of them, *Lecane blachei*, *Filinia camasecla* and *Brachionus*

donneri were first recorded in Cambodia by Berzins 1973. Another 125 taxa are new record to Cambodia (Figs 2–5), to add rotifers fauna for country from 4 species (Berzins, 1973) reach to 129 species.



Figures 2 Some rotifers recorded from Cambodia during this study. (a) *Brachionus calyciflorus*; (b) *B. forficula*; (c) *B. quadridentatus*; (d) *Lecance curvicornis*; (e) *L. stenroosi*; (f) *Plationus patulus*; (g) *Ploesoma hudsoni*; (h) *Testudinella patina*; (i) *Lecane quadridentata*; (j) *L. leontina*; (k) *Trichotria tetractis*.



Figures 3 Scanning electron microscope (SEM) photos of rotifers were recorded from Cambodia. (l) *Platyias quadricornis*; (m) *Brachionus angularis* (n) *Lecane bulla*; (o) *L. leontina*; (p) *Brachionus quadridentatus*; (q) *Mytilinia ventralis*



Figure 4 SEM trophi of *Platyias quadricornis*

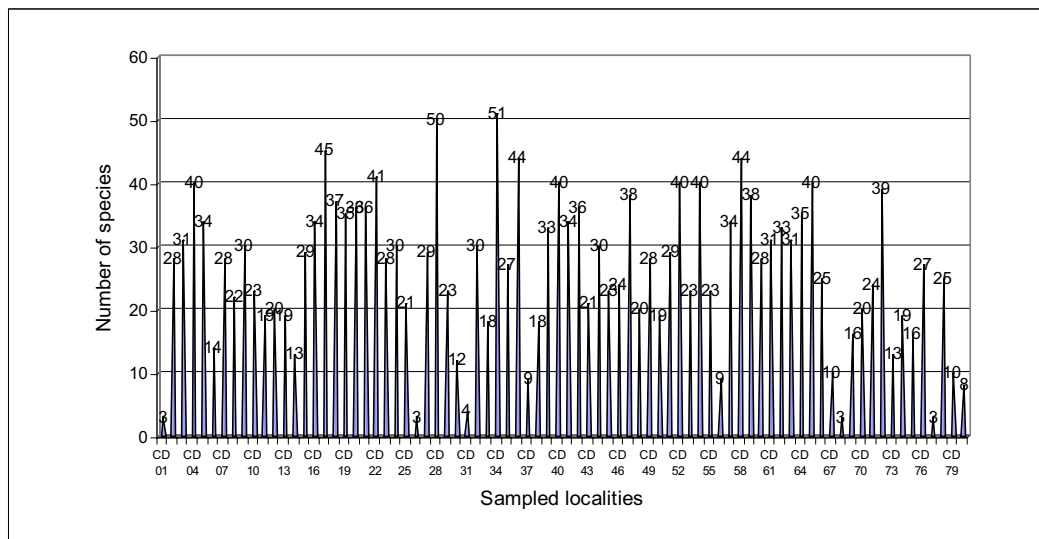


Figure 5 Number of species found in each sampled localities.

Table 2 Rotifera recorded from Cambodian Mekong River basins during this study.

Anuraeopsis coelata (De Beauchamp, 1932)

A. fissa (Gosse, 1851)

Ascomorpha ecaudis Perty, 1850

Asplanchna priodonta Gosse, 1850

Asplanchnella brightwelli vor. Donner, 1977

Brachionus angularis (Ahlstrom, 1940)

B. bidentata (Anderson, 1889)

B. budapestinensis Daday, 1885

B. calyciflorus Pallas, 1766

B. caudatus Arrois & Daday, 1894

B. dichotomus Shepherd, 1911

B. donneri Brehm, 1951

B. falcatus (Zacharias, 1898)

B. forficula Wierzejsky, 1891

B. kostei Shiel, 1983

B. murphyi Sudzuki, 1989

B. quadridentatus Hermann, 1783

B. rubens Ehrenberg, 1838

Cephalodella gibba Harring & Myers, 1924

Colurella uncinata (Muller, 1773)

Dicranopharus caudatus (Ehrenberg, 1834)

D. epicharis Harring & Myers, 1928

Dipleuchanis claviger (Hauer, 1965)

D. propatula (Gosse, 1886)

Euchlanis dilatata Ehrenberg, 1832

E. incisa Carlin, 1939

Filinia camasecla Myers, 1938

F. longiseta (Ehrenberg, 1832)

F. novaezealandiae Shiel & Sanoamuang, 1993

F. opoliensis (Zacharias, 1898)

Hexarthra intermedia Wiszniewski, 1929

Keratella cochlearis (Gosse, 1856)

K. edmondsoni Ahlstrom, 1943

K. lenzi Hauer, 1953

K. tecta (Gosse, 1851)

K. tropica (Apstein, 1937)

Lecane aculeata (Jakubski, 1913)

L. aeganea Harring, 1914

L. baimaii Sanoamuang & Savatnalinton 1999

L. blachei (Berzins, 1973)

L. bulla (Gosse, 1851)

Table 2 Rotifera recorded from Cambodian Mekong River basins during this study. (Cont.)

<i>L. closteroerca</i> Koste, 1978	<i>L. heterostyla</i> Harring, 1916
<i>L. crepida</i> Harring, 1914	<i>L. latusinus</i> (Hilgendorf, 1898)
<i>L. curvicornis</i> (Murray, 1913)	<i>L. obtusa</i> Wang, 1961
<i>L. decipiens</i> (Murray, 1913)	<i>L. ovalis</i> (Murray, 1913)
<i>L. elegans</i> Harring, 1914	<i>L. patella</i> (O. F. Muller, 1786)
<i>L. elongata</i> Pawlowski, 1938	<i>L. quadricarinata</i> (Stenroos, 1898)
<i>L. furcata</i> (Murray, 1913)	<i>L. quinquecostata</i> (Lucks, 1912)
<i>L. halyclista</i> Harring & Myers, 1926	<i>L. rhomboides</i> (Gosse, 1886)
<i>L. hamata</i> (Stockes, 1896)	<i>Lophocharis salpina</i> (Ehrenberg, 1834)
<i>L. hastata</i> (Murray, 1913a)	<i>Macrochaetus collinsi</i> (Gosse, 1867)
<i>L. hornemanni</i> (Ehrenberg, 1834)	<i>M. danneeli</i> Koste & Shiel, 1983
<i>L. lateralis</i> Sharma, 1978	<i>M. sericus</i> (Thorpe, 1893)
<i>L. leontina</i> (Turner 1892)	<i>Mytilina acanthophora</i> Hauer, 1938
<i>L. ludwigii</i> Harring, 1913	<i>M. bisulcata</i> (Lucks, 1850)
<i>L. luna</i> (O.F Müller, 1776)	<i>M. unguipes</i> (Lucks, 1912)
<i>L. lunaris</i> (Ehrenberg, 1832)	<i>M. ventralis</i> (Ehrenberg, 1832)
<i>L. obtusa</i> (Murray, 1913)	<i>Monommata dentata</i> Wulfert, 1940
<i>L. papuana</i> (Murray, 1913)	<i>Plationus patulus</i> (Müller, 1786)
<i>L. pertica</i> Harring, 1914	<i>Ploesoma hudsoni</i> (Imhof, 1891)
<i>L. pusilla</i> Harring, 1914	<i>P. lenticulare</i> Herrick, 1885
<i>L. quadridentata</i> (Ehrenberg, 1832)	<i>Platyias quadricornis</i> (Ehrenberg, 1832)
<i>L. rhenana</i> Hauer, 1929	<i>Polyarthra vulgaris</i> (Carlin, 1943)
<i>L. rhytida</i> Harring & Myers, 1926	<i>Pompholyx complanata</i> Gosse, 1851
<i>L. segersi</i> Sanoamuang, 1996	<i>Scaridium longicuadium</i> (Muller, 1786)
<i>L. signifera</i> (Jennings, 1896)	<i>Synchaeta pectincta</i> Ehrberg, 1832
<i>L. sola</i> Hauer, 1936	<i>S. stylata</i> Wierzejski, 1893
<i>L. stenroosi</i> (Meissner, 1908)	<i>Testudinella ahlstromi</i> Hauer, 1956
<i>L. thailandensis</i> Segers & Sanoamuang, 1994	<i>T. brevicaudata</i> Yamamoto, 1951
<i>L. thienemanni</i> (Hauer, 1938)	<i>T. greeni</i> Koste, 1981
<i>L. unguitata</i> (Fadeev, 1925)	<i>T. patina</i> Hermann, 1783
<i>L. ungulata</i> (Gosse, 1887)	<i>T. tridentata</i> Smimov, 1931
<i>Lepadella acuminata</i> (Ehrenberg, 1834)	<i>Trichocerca bicristata</i> (Gosse, 1887)
<i>L. cristata</i> (Ousselet, 1893)	<i>T. capucina</i> (Wierzejski & Zacharias, 1893)
<i>L. dactyliseta</i> (Stenroos, 1898)	<i>T. chattoni</i> (de Beauchamp, 1907)
<i>L. discoidea</i> Segers, 1993	<i>T. elongata</i> (Gosse, 1886)
	<i>T. cylindrical</i> (Sudzuki, 1956)
	<i>T. flagellata</i> Hauer, 1937

Table 2 Rotifera recorded from Cambodian Mekong River basins during this study. (Cont.)

<i>T. insignis</i> Carlin, 1939
<i>T. insulana</i> (Hauer, 1937)
<i>T. longiseta</i> (Schank, 1802)
<i>T. montana</i> Hauer, 1952
<i>T. musculus</i> (Hauer, 1935)
<i>T. myersi</i> (Hauer, 1931)
<i>T. ruttneri</i> Donner, 1953
<i>T. porcellus</i> Myers, 1937
<i>T. similis</i> (Wierzejski, 1892)
<i>T. stylata</i> (Eyferth, 1878)
<i>T. trigris</i> (Muller, 1786)
<i>T. tropis</i> Hauer, 1937
<i>T. vernalis</i> (Hauer, 1936)
<i>Trichotria tetractis</i> (Ehrenberg, 1830)
<i>Wolga spinifera</i> (Western, 1894)

The number of species found in each locality rang from 3–51 species (Fig. 5).

The most common species were *Polyarthra vulgaris* (91.2% of sampled localities) follow by *Lecane bulla* (88%), *L. leontina* (85%), *Platyonus patulus* (75%), *L. unguitata* (73.7%), *Testudinella patina* (71.2%).

The highest species diversity were recorded from Chorchork swamp (CD 34) in Prey Veng Province (latitude 11° 32' 55" N, longitude 105° 23' 35" E, altitude 19m, temperature 33.3 °C, pH 6.8, and electro conductivity 60 µS) with 51 species, follow by Chrolong swamp (CD 28) in Prey Veng Province (50 species), Toul Krasain swamp (CD 17) in Kandal Province (45 species), Sway Antor swamp (CD 36) in Prey Veng anv Ampel Thom swamp (CD 58) in Kampong

Cham Province (44 species), Steung Khlot swamp (CD 22) in Prey Veng Province (41 species), Prek Angkugn canal (CD 04) in Kandal Province, Kdieng Reay swamp (CD 40), Tourlpo swamp (CD 52) and Matt Khmourng Lake (CD 54) in Kampong Cham Province and Kampong Trach rice field (CD 65) in Kampong Chhnang Province (40 species). The lowest species diversity found in Srey Snam rice field (CD 01) in Kandal Province, Krang Sway canal (CD 26) in Prey Veng Province, Prey Pey canal (CD 188) and Pomreh canal (CD 197) in Kampong Chhnang Province with 3 species.

The rarely species diversity were *Brach-onus budapestinensis*, *B. murphyi*, *B. rubens*, *Cephalodella gibba*, *Lecane aeganea*, *L. decip-iens*, *L. elegans*, *L. elongata*, *L. pussilla*, *L. seger*, *L. sola*, *Lepadella. cristata*, *L. daetyliseta*, *L. obtusa*, *L. quadricarinata*, *Mytilina acantho-phora*, *Synchaeta stylata*, *Trichocerca cylindrical*, *Tr. insulana*, *Tr. longiseta*, *Tr. musculus*, *Tr. nuttneri* and *Tr. trigris* found in one sampled localities (1.2% of sampled localities).

The most diverse genera were *Lecane* (28.1%, 36 species), followed by *Trichocerca* (14.8%, 19 species), *Brachionus* (10.2%, 13 species), *Lepadella* (9.4%), 12 species), *Testudi-nella* (4%, 5 species), *Keratella*, *Filinia* and *Mytilina* (3.2%, 4 species), *Macrochaetus* (2.3%, 3 species), *Anuraeopsis*, *Dicranopharus*, *Dipleuch-anis*, *Euchlanis*, *Ploesoma* & *Synchaeta* (1.5%, 2 species), and *Ascomorpha*, *Asplanchna*, *Asplanchnella*, *Cephalodella*, *Coleurella*, *Hexarthra*, *Lopho-charis*, *Monommata*, *Platona*, *Platyias*, *Polyar-thra*, *Pompholyx*, *Scaridium*, *Trichotria*, *Wolga* (1 species). This result relates to the

previous recorded of Sanoamuang and Savatnalinton, 2001 as *Lecane* is the most diverse genus found in Lake Kud Thing, Nong Khai Province, northeast Thailand, and it's also the most diverse genus in the Southeast Asia (Segers, 2001).

All species found in this study are previously reported in Southeast Asia which some are endemic species, e.g.

1. *Brachionus murphyi* Sudzuki, 1989 is Eastern Oriental taxon recorded from Singapore (Sudzuki, 1989), Thailand (Sanoamuang et al., 1995: sub. *B. niwati* Sanoamuang et al., 1995: new synonym), Hainan, South China (Koste and Zhuge, 1998: sub. *B. niwati*).

2. *L. segersi* Sanoamuang is a Thai endemic species that were described from Northeast Thailand (Sanoamuang and Segers, 1997).

3. *L. thailandensis* Segers and Sanoamuang Known from China, Northeast and Southern Thailand (Segers, 1995a; Sanoamuang and Segers, 1997).

4. *L. baimaii* Sanoamuang & Savatnalinton first found at Nakhon Rachasima province, Northeast part of Thailand by Sanoamuang and Savatnalinton 1999 and described as new to science.

We did not find any specimen of the *Anchitest-udinella mekongensis* Berzins in any part of Cambodian Mekong River environment. However, it was previously recorded by Berzins, 1973 from Prek Andor, a river flowing into the Mekong, Kandal Province (13 July 1950).

Correlation analysis showed that pH tend to be positively related to species diversity ($r = 0.243$, $p < 0.05$)

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