

Diversity of Rotifer Fauna from Five Coastal Peat Swamps on Phuket Island, Southern Thailand

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ABSTRACT: A total of 133 rotifer species was identified from five coastal peat swamps on Phuket Island. Of these, *Dicranophoroides* sp.A and *Harringia rousseleti* were new to Thailand. The most speciose genus was *Lecane* (30.82%), followed by *Lepadella* (12.03%). The highest species richness occurred in Jae-Son (100 species), followed by Jik (84 species), Jood (67 species), Mai-Khao (65 species) and Sra-Boua (48 species), respectively. One hundred and ninety-three rotifer species are now known from peat swamps in Thailand.

KEYWORDS: rotifer, taxonomy, biogeography, peat swamp, species richness.

INTRODUCTION

Soon after commencement of studies on the rotifer fauna of peat swamps, it became clear that they contained many extraordinary species^{1,2,3,4,5}. This is suggested to be the result of the long history of rotifers and unique ecological characteristics of the habitats, making them valuable natural environments with a high conservation value⁵. Among the many peat swamp areas in Thailand, one of most interesting habitat type is that of coastal peat swamp. Such peat swamps are located parallel to the coastal line and at a distance of approximately 0.5 km from the beach. The water characteristics are close to those of other peat swamps: fresh, brownish and slightly acidic. One of the coastal peat swamps in Phuket province, Phru Ban Mai-Khao, has been fragmented into several small swamps, due to natural succession and human activities. In order to extend knowledge on peat swamp rotifers, this research work aimed to investigate rotifer species inhabiting five coastal peat swamps along the Mai-Khao coast on Phuket Island, southern Thailand.

MATERIALS AND METHODS

Samples were collected from five peat swamps, Mai-Khao, Jood, Jik, Jae-Son and Sra-Boua, along the Mai-Khao coast in Phuket province during November, 1999 to February, 2001. In order to obtain a representative overview of the composition of the rotifer fauna in each peat swamp, sample sites were selected to represent the local size and diversity of microhabitat types in each area. The more heterogeneous the swamp, the larger the number of samples collected. Qualitative samples were collected on a monthly basis by approximately 10 m-long horizontal hauls using a 26 mm plankton net. The material was immediately preserved in 5% formaldehyde solution. On return to the laboratory, rotifers were sorted under an Olympus VM dissecting microscope. They were identified and counted under an Olympus CH-2 compound microscope. Identification was mainly focused on Monogononta species, with particular attention to the taxonomically less demanding loricate species. Some specimens were drawn, others were

Table 1. Some parameters from five peat swamps along the Mai-Khao coast on Phuket Island, measured during the sampling period from November 1999 to February 2001.

Peat swamps	Temperature(°C)	Dissolved Oxygen (mg.l ⁻¹)	pH	Salinity(ppt)	Conductivity(×10 ⁻² mS. cm ⁻¹)	Turbidity(NTU)
Jik	27.2 - 32.9	2.2 - 7.5	5.1 - 7.4	0	3.5 - 7.4	3 - 37
Mai-Khao	26.7 - 36.5	0.2 - 9	5.6 - 9.2	1.4 - 7.4	280 - 1300	4 - 151
Jood	26 - 37.7	0.2 - 12.8	5.4 - 7.8	0.9 - 5.1	192 - 920	1 - 63
Jae-Son	24.3 - 35.4	3.3 - 9	5.2 - 8.2	0	2.7 - 10.2	2 - 60
Sra-Boua	26.7 - 34.8	3.0 - 14	5.5 - 7.8	0 - 1	8.1 - 26.9	17 - 374

Table 2. List of rotifer fauna from five coastal peat swamps in Phuket province, southern Thailand (1 = Mai-Khao, 2 = Jood, 3 = Jik, 4 = Jae-Son, 5 = Sra-Boua, # = new to Thailand and * = new record to Oriental region).

Rotifer fauna	Rotifer fauna
<i>Anuraeopsis coelata</i> (De Beauchamp) 3,4,5	<i>L. lunaris</i> (Ehrenberg) 1,3,4,5
<i>A. fissa</i> (Gosse) 1,2,3,4,5	<i>L. monostyla</i> (Daday) 1,2,3,4
<i>A. navicula</i> Rousselet 1,2,3,4,5	<i>L. obtusa</i> (Murray) 1,2,3,4,5
<i>Ascomorpha ovalis</i> (Bergendahl) 3,4	<i>L. palinacis</i> Harring and Myers 3
<i>Asplanchna sieboldi</i> (Leydig) 3,4	<i>L. pyriformis</i> (Daday) 1,2,3,4,5
<i>Brachionus angularis</i> Gosse 1,2,5	<i>L. quadridentata</i> (Ehrenberg) 3
<i>B. calyciflorus</i> Pallas 2,5	<i>L. rhenana</i> Hauer 4
<i>B. dichotomus</i> Shephard 2,3,4	<i>L. rhytida</i> Harring and Myers 1,2,3,4
<i>B. donneri</i> Brehm 3,4	<i>L. robertsonae</i> Segers 3,4
<i>B. falcatus</i> Zacharias 1,3,4,5	<i>L. segersi</i> Sanoamuang 1,2,5
<i>B. forficula</i> Wierzejski 3,4	<i>L. signifera</i> (Jennings) 1,4,5
<i>B. lyratus</i> Shephard 3	<i>L. subtilis</i> Harring and Myers 4
<i>B. murphyi</i> Sudzuki 4,5	<i>L. superaculeata</i> Sanoamuang and Segers 5
<i>B. quadridentatus</i> Hermann 1,2,3,4,5	<i>L. tenuiseta</i> Harring 1,2,3,4
<i>B. rotundiformis</i> Tschugunoff 1,2	<i>L. thienemanni</i> (Hauer) 4
<i>B. urceolaris</i> (Müller) 1,2,3,4	<i>L. undulata</i> Hauer 1,2,3,4,5
<i>Cephalodella forficula</i> (Ehrenberg) 1,2,3,4,5	<i>L. unguitata</i> (Fadeev) 1,3,4,5
<i>C. gibba</i> (Ehrenberg) 1,2,3,4,5	<i>L. ungulata</i> (Gosse) 4
<i>C. innesi</i> Myers 1,2,4	<i>Lepadella acuminata</i> (Ehrenberg) 1,2,3,4,5
<i>C. tenuior</i> (Gosse) 1,4	<i>L. apsicora</i> (Myers) 2,4
<i>Collothea</i> sp. 4	<i>L. apsidea</i> Harring 1,2,3
<i>Colurella adriatica</i> Ehrenberg 4	<i>L. costatoides</i> Segers 4
<i>C. colurus</i> (Ehrenberg) 1,3	<i>L. desmeti</i> Segers and Chittapun 1,2,3,4
<i>C. obtusa</i> (Gosse) 1,2,3,4	<i>L. ehrenbergi</i> (Perty) 3,4
<i>C. psammophila</i> Segers and Chittapun 1	<i>L. eurysterna</i> Myers 1,2,3,4,5
<i>C. sanoamuangae</i> Chittapun, Pholpunthin and Segers 1,2,3	<i>L. latusinus</i> (Hilgendorf) 3,4
<i>C. sulcata</i> (Stenroos) 3,4	<i>L. minoruoides</i> Koste and Robertson 3,4
<i>C. tessellata</i> (Glascott) 1,3,4	<i>L. monodactyla</i> Berzins 3
<i>C. uncinata</i> (Müller) 1,2,3,4,5	<i>L. ovalis</i> (Müller) 3,4
<i>Conochilus natans</i> (Seligo) 3,4	<i>L. patella</i> (Müller) 1,2,3,4,5
<i>Dicranophorus epicharis</i> Harring and Myers 1,2,3,4,5	<i>L. rhomboides</i> (Gosse) 1,2,3,4,5
#* <i>Dicranophoroides</i> sp.A 3	<i>L. triba</i> Myers 3,4,5
<i>Dipleuchlanis propatula</i> (Gosse) 4	<i>L. triptera</i> (Ehrenberg) 4
<i>Dissotrocha aculeata</i> (Ehrenberg) 4	<i>L. vandenbrandei</i> Gillard 3,4
<i>Ecnentrum pornsilpi</i> Segers and Chittapun 1,2,4	<i>Macrochaetus collinsi</i> (Gosse) 2,3,4
<i>Euchlanis dilatata</i> Ehrenberg 2,3,4,5	<i>Monommata dentata</i> Wulfert 1,2,3,4
<i>Filinia longiseta</i> (Ehrenberg) 2,3,5	<i>M. grande</i> Tessin 4
<i>F. opoliensis</i> (Zacharias) 2,3,4	<i>Mytilina ventralis</i> (Ehrenberg) 1,3,4
<i>Floscularia conifera</i> (Hudson) 1,2,3,4	<i>Notommata copeus</i> Ehrenberg 3
# <i>Harringia rousseleti</i> De Beauchamp 3	<i>N. saccigera</i> Ehrenberg 1,2,3,4
<i>Hexarthra mira</i> (Hudson) 1,2,3,4	<i>Platyonus patulus</i> (Müller) 2
<i>Keratella cochlearis</i> (Gosse) 3,4	<i>Platylas quadricornis</i> (Ehrenberg) 5
<i>K. tropica</i> (Apstein) 1,2,3,4,5	<i>Polyarthra vulgaris</i> Carlin 1,2,3,4,5
<i>Lecane abanica</i> Segers 1	<i>Proales</i> sp. 1,2,3,4,5
<i>L. acanthinula</i> (Hauer) 1,2	<i>Scaridium bostjani</i> Daems and Dumont 3
<i>L. aculeata</i> (Jakubski) 1,2,3,4	<i>S. longicaudum</i> (Müller) 1,3,4
<i>L. arcua</i> Harring 1,2,3,4,5	<i>Squatinella mutica</i> (Ehrenberg) 2,3,4
<i>L. batillifer</i> (Murray) 4	<i>Synchaeta</i> sp. 3
<i>L. bifurca</i> (Bryce) 1,2	<i>Taphrocampa annulosa</i> Gosse 2
<i>L. bulla</i> (Gosse) 1,2,3,4,5	<i>Testudinella amphora</i> Hauer 4
<i>L. closteroerca</i> (Schmarda) 1,2,3,4,5	<i>T. emarginula</i> (Stenroos) 3,4,5
<i>L. crepida</i> Harring 2,4	<i>T. patina</i> (Hermann) 1,2,4,5
<i>L. curvicornis</i> (Murray) 1,2,3,4,5	<i>Trichocerca bidens</i> (Lucks) 2,3,4
<i>L. doryssa</i> Harring 2,4	<i>T. braziliensis</i> (Murray) 1,2,4
<i>L. flexilis</i> (Gosse) 2,4	<i>T. capucina</i> Wierzejski and Zacharias 3,4
<i>L. furcata</i> (Murray) 1,2,3,4,5	<i>T. chattoni</i> (De Beauchamp) 3,4
<i>L. grandis</i> (Murray) 1,2	<i>T. flagellata</i> Hauer 3
<i>L. haliclysta</i> Harring and Myers 5	<i>T.cf. gracilis</i> (Tessin) 3,4
<i>L. hamata</i> (Stokes) 1,2,3,4,5	<i>T. hollaerti</i> De Smet 5
<i>L. hastata</i> (Murray) 1,2,3,4	<i>T. insulana</i> (Hauer) 1,4
<i>L. hornemanni</i> (Ehrenberg) 1,2,4	<i>T. mus</i> Hauer 5
<i>L. inermis</i> (Bryce) 1,2,3,4,5	<i>T. pusilla</i> (Lauterborn) 1,2,3,4,5
<i>L. lateralis</i> Sharma 4	<i>T. ruttneri</i> Donner 3,4
<i>L. leontina</i> (Turner) 5	<i>T. similis</i> (Wierzejski) 2,3,4,5
<i>L. ludwigii</i> (Eckstein) 1,4	<i>T. tenuior</i> Gosse 1,2,5
<i>L. luna</i> (Müller) 1,2,4	<i>T. tigris</i> (Müller) 4
	<i>T. weberi</i> (Jennings) 5

photographed and some SEM pictures were also taken following Chittapun and Pholpunthin (1999) and Chittapun et al. (2003). Temperature, salinity, dissolved oxygen, pH, conductivity and turbidity were measured during the sampling period (Table 1).

RESULTS

Species composition of Rotifera in five coastal peat swamps

One hundred and thirty-two monogonont and one bdelloid species of rotifer (Table 2), distributed over 34 genera and 21 families, were identified from five peat swamps along the Mai-Khao coast in Phuket province. The most speciose genus was found to be *Lecane* (30.82% of the species), followed by *Lepadella* (12.03%) and *Trichocerca* (11.28%). This result is in accord with existing knowledge on the rotifer composition from all previously studied peat swamp areas^{1,2,4}. Moreover, the result confirms reports that *Lecane* is the most diverse rotifer genus in the tropical region^{6,7,8}.

Additionally, the composition of the peat swamp rotifer community agrees with the report from Thala-Noi, located in the south of Thailand⁹. In contrast to the results, many wetlands located in northeast Thailand (e.g., Lake Kud-Thing in Nong Khai province)^{10,11} have reported *Brachionus* as the second most diverse genus. This suggests that the composition of rotifer communities varies throughout Thailand, probably as a result of climatic and ecological differences. In the present study, the most speciose peat swamp is Jae-Son (100 species), followed by Jik (84 species), Jood (67 species), Mai-Khao (65 species) and Sra-Boua (48 species), respectively.

Of the 133 taxa on record, 23 species (17.29%) can be considered as common rotifer species, present in all areas and 34 species (25.56%) were only found in one area (Table 2). In addition, *Dicranophoroides* sp. A (Fig. 1) and *Harringia rousseleti* (Fig. 2) are new to Thailand. The first species, *Dicranophoroides* sp. A, is morphologically different from extant species in the genus¹². It is probably a new species. *Harringia rousseleti*, on the other hand, is cosmopolitan, but rare¹³. These records confirm that the peat swamp areas contain many remarkable rotifer species.

Notes on *Dicranophoroides* sp. A (Fig. 2)

Only a single specimen was found from Jik peat swamp. The external characteristic of the preserved specimen is similar to *Dicranophorus epicharis*, but its trophi agrees well with genus *Dicranophoroides*. Trophi looks like *D. australiensis*, but the undulate outer ramus margin, the shape of the fulcrum and apical rami teeth are different¹². It is probably a new species.

Trophi forcipate is symmetrical. Rami had subbasal



Fig 1. The SEM picture of *Dicranophoroides* sp. A trophi.

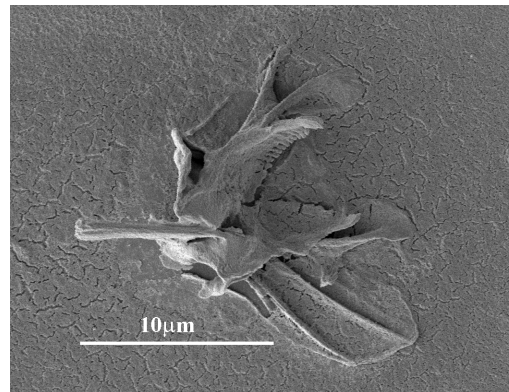


Fig 2. The SEM picture of *Harringia rousseleti* trophi.

chambers terminating in squares with curved angle expansion with 3 stout subapical teeth, projecting inwardly; inner margin without teeth; basal chamber lateral and lamellar, inwardly projecting teeth not projecting beyond apical teeth of subbasal chamber. The fulcrum is short, c. $\frac{1}{4}$ ramus length, stout triangular, and its posterior strongly expanded. Unci with a principle stout single tooth broadly expand before offset tips. Its Manubria ramus is long, posteriorly expanded, and curved.

The measurements of these parts were trophi: 28.98 μm , ramus: 23.57 μm , fulcrum: 5.41 μm , and unci: 12.74 μm

Zoogeography of genus *Brachionus*, *Lecane* and *Trichocerca* (Table 3)

To date, 57 species of *Brachionus*, 177 *Lecane* and 67 *Trichocerca* are recognized worldwide^{5,11,13-27}. Of these,

Table 3. Distribution of rotifers in genera *Brachionus*, *Lecane* and *Trichocerca* of the five coastal peat swamps.

Brachionus (11 species – 19.30%)	
Cosmopolitan taxa (4 species – 36.37%)	
<i>Brachionus angularis</i> Gosse	<i>B. quadridentatus</i> Hermann
<i>B. calyciflorus</i> Pallas	<i>B. urceolaris</i> (Müller)
Tropicopolitan taxa (3 species – 27.27%)	
<i>B. donneri</i> Brehm	<i>B. falcatus</i> Zacharias
<i>B. rotundiformis</i> Tschugunoff	
Australasian taxa (2 species – 18.18%)	
<i>B. lyratus</i> Shephard	<i>B. dichotomus</i> Shephard
Oriental taxon (1 species – 9.09%)	
<i>B. murphyi</i> Sudzuki	
Eastern hemisphere taxon (1 species – 9.09%)	
<i>B. forficula</i> Wierzejski	
Lecane (41 species – 23.16%)	
Cosmopolitan taxa (14 species – 34.15%)	
<i>Lecane bifurca</i> (Bryce)	<i>L. ludwigii</i> (Eckstein)
<i>L. bulla</i> (Gosse)	<i>L. luna</i> (Müller)
<i>L. closteroerca</i> (Schmarda)	<i>L. lunaris</i> (Ehrenberg)
<i>L. furcata</i> (Murray)	<i>L. pyriformis</i> (Daday)
<i>L. flexilis</i> (Gosse)	<i>L. quadridentata</i> (Ehrenberg)
<i>L. hamata</i> (Stokes)	<i>L. ungulata</i> (Gosse)
<i>L. inermis</i> (Bryce)	<i>L. tenuiseta</i> Harring
Tropicopolitan taxa (18 species – 43.90%)	
<i>L. aculeata</i> (Jakubski)	<i>L. leontina</i> (Turner)
<i>L. arcua</i> Harring	<i>L. monostyla</i> (Daday)
<i>L. crepida</i> Harring	<i>L. obtusa</i> (Murray)
<i>L. curvicornis</i> (Murray)	<i>L. palinacis</i> Harring and Myers
<i>L. doryssa</i> Harring	<i>L. rhenana</i> Hauer
<i>L. grandis</i> (Murray)	<i>L. rhytida</i> Harring and Myers
<i>L. halicylsta</i> Harring and Myers	<i>L. signifera</i> (Jennings)
<i>L. hastata</i> (Murray)	<i>L. subtilis</i> Harring and Myers
<i>L. hornemanni</i> (Ehrenberg)	<i>L. undulata</i> Hauer
Pantropical taxa (2 species – 4.88%)	
<i>L. robertsonae</i> Segers	<i>L. thienemanni</i> (Hauer)
Eastern hemisphere taxa (5 species – 12.20%)	
Widely distributed (1 species – 2.44%)	
<i>L. abanica</i> Segers	
Palaeotropical taxa (2 species – 4.88%)	
<i>L. lateralis</i> Sharma	<i>L. unguitata</i> (Fadееv)
Oriental taxon (1 species – 2.44%)	
<i>L. acanthinula</i> (Hauer)	
Australasian taxon (1 species – 2.44%)	
<i>L. batillifer</i> (Murray)	
Endemic to Thailand (2 species – 4.88%)	
<i>L. segersi</i> Sanoamuang	<i>L. superaculeata</i> Sanoamuang and Segers
Trichocerca (15 species – 22.39%)	
Cosmopolitan taxa (7 species – 46.67%)	
<i>Trichocerca bidens</i> (Lucks)	<i>T. tenuior</i> Gosse
<i>T. capucina</i> Wierzejski and Zacharias	<i>T. tigris</i> (Müller)
<i>T. pusilla</i> (Lauterborn)	<i>T. weberi</i> (Jennings)
<i>T. similis</i> (Wierzejski)	
Warm-water taxa (5 species – 33.33%)	
<i>T. braziliensis</i> (Murray)	<i>T. insulana</i> (Hauer)
<i>T. chattoni</i> (De Beauchamp)	<i>T. flagellata</i> Hauer
<i>T. ruttneri</i> Donner	
Pan(sub)tropical taxa (2 species – 13.33%)	
<i>T. hollaerti</i> De Smet	<i>T. mus</i> Hauer
Insufficient data (1 species – 6.67%)	
<i>T. cf. gracilis</i> (Tessin)	

11 (19.30%), 41 (23.16%) and 16 (22.39%) of the species in those genus, respectively, were recorded from the five peat swamps (Table 2). For *Brachionus*, four species are cosmopolitan, three are Tropicopolitan, two are Australasian, one is an Oriental taxon and one is an Eastern hemisphere taxon^{13,28,29,30}. Of *Lecane*, most are widely distributed, cosmopolitan (14 species) and Tropicopolitan taxa (18 species). There are one Oriental and two Thai endemics^{8,30}. In addition, all *Trichocerca* species reported are widely distributed, except *T. cf. gracilis*, for which there are insufficient data and the identification of which is unconfirmed. Most of them are cosmopolitan taxa (7 species), followed by tropicopolitan taxa and Pan(sub)tropical taxa (5 species and 2 species), respectively²⁷. The results indicate that, while some *Brachionus* and *Lecane* are endemic to the Oriental region, there is no regional endemism in *Trichocerca*. This corresponds with the existing knowledge on biogeography of these three genera of rotifer fauna^{8,27,28,29}.

DISCUSSION

To date, 193 Rotifera from 21 families were recorded from nine peat swamp areas. This represents more than half of the Thai rotifer fauna^{1-5,9-11,16,19,25,31-33}. Of these 193 species, 14 have been reported as first record from the Oriental region, and 28 had been reported as first record from Thailand. According to the total list of peat swamp rotifers, the most speciose genera are *Lecane* (30.21%), followed by *Trichocerca* (11.46%) and *Lepadella* (10.42%), respectively. *Lecane* is abundant in the littoral or acidic water, which corresponds with the characteristic of peat swamps⁶⁻⁸. However, that *Trichocerca* is the second richest group of the total list of peat swamp rotifers, instead of *Lepadella*, in contrast to other reports from the area^{1,2,4}. Different species of *Trichocerca* in each area contribute to the disparity, whereas *Lepadella* species are found in common between areas. In addition, six species were described as new to science^{1,3-5}. Of these, all except *Lepadella desmeti* are endemic not only to peat swamps but also to the southern part of Thailand. Moreover, these new species increase the number of endemic taxa in the Oriental region from 8 to 13 taxa³⁰.

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