REFERENCES

Boonsom, J. 1984. The freshwater zooplankton of Thailand (Rotifera and Crustacea). *Hydrobiologia* 113:223-229.

Chittapun, S., Pholpunthin, P. and Segers, H. 1999. Rotifera from peat-swamps in Phuket province, Thailand, with the description of a new *Colurella* BORY DE ST. VINCENT. *Internat. Rev. Hydrobiol.* 84(6):587-593.

Chittapun, S. and Pholpunthn, P. 2001. The rotifer fauna of peat-swamps in southern Thailand. *Hydrobiologia* 446/447:255-259.

Chittapun, S., Pholpunthin, P. and Segers, H. 2002. Rotifer diversity in a peat-swamp in southern Thailand (Narathiwas province) with the description of a new species of *Keratella* Bory de St. Vincent. *Ann. Limnol.* 38(3):185-190.

Chittapun, S., P. Pholpunthin, and H. Segers. 2003. Contribution to the knowledge of Thai microfauna diversity: notes on rare peat swamp Rotifera, with the description of a new *Lecane* Nitzsch, 1872. *Hydrobiologia* 501: 7-12.

Cole, G. A. 1994. *Textbook of limnology* (4th ed.), 412 pp. Illinois: Waveland Press.

Fernández-Casalderrey, A., M. D. Ferrando and E. Andreu-Moliner. 1993. Chronic toxicity of methylparathion to the rotifer *Brachionus calyciflorus* fed on *Nannochloris oculata* and *Chlorella pyrenoidosa*. *Hydrobiologia* 255/256: 41-49.

Ferrando, M. D., C. R. Janseen, E. Andreu and G. Persoone. 1993. Ecotoxicological studies with the freshwater rotifer *Brachionus calyciflorus*. II. An assessment of the chronic toxitcity of lindane and 3,4-dichloroaniline using life tables. *Hydrobiologia* 255/256: 33-40.

Finlayson, M. and M. Moser. 1991. *Wetland*, 224 pp. New York: Fact on File.

Janssen, C. R., M. D. Ferrando Rodrigo and G. Persoone. 1993. Ecotoxicological studies with the freshwater rotifer *Brachionus calyciflorus*. I. Conceptual framework and applications. *Hydrobiologia* 255/256: 21-32.

Keddy, P. A. 2000. *Wetland Ecology (Principles and Conservation)*, 614 pp. Cambridge: Cambridge University Press.

Koste, W. 1975. Über den Rotatorienbestand einer mikrobiozönose in einem tropischen aquatischen saumbiotop, der *Eichhornia-crassipes*-zone im litoral des Bung-Borapet, einem stausee in zentralthailand. *Gewässer und Abwässer* 57/58: 43-58.

Lubzens, E., Y. Wax, G. Minkoff and F. Adler. 1993. A model evaluating the contribution of environmental factors to the production of resting eggs in the rotifer *Brachionus plicatilis. Hydrobiologia* 255/256: 127-138.

Mäemets, A. 1983. Rotifers as indicators of lake types in Estonia. *Hydrobiologia* 104: 357-361.

Marneffe, Y., S. Combin and J. P. Thomé. 1998. Ecological water quality assessment of the Bütgenbach lake (Belgium) and its impact on the River Warche using rotifers as bioindicators. *Hydrobiologia* 387/388: 459-467.

Miller, S.A. and Harley, J.P. 1996. *Zoology* (3rd ed.), 752 pp. Boston: Mc Graw-Hill Companies.

Nogrady, T. and T. L. A. Rowe. 1993. Comparative laboratory studies of narcosis in *Brachinus plicatilis*. *Hydrobiologia* 255/256: 51-56.

Nogrady, T., Wallace, R. L. and Snell. T. W. 1993. Guides to the Identification of the Microinvertebrates of the Continental Waters of the World; Volume 1: Biology, Ecology and Systematics. SPB Academic Publishing. 142 pp.

Pechenik, J. A. 2000. *Biology of the Invertebrate* (4th ed.), 578 pp. Boston: Mc Graw-Hill Companies.

Phengklai, C., C. Niyomdham, A. Premrasmi, K. Chirathanakorn and R. Phuma. 1989. Peat Swamp Forest of Thailand. *Thai For. Bull.* 18: 1-42.

Pholpunthin, P. 1997. Freshwater zooplankton (Rotifera, Cladocera and Copepod) from Thale-Noi, south Thailand. *J. Sci. Soc. Thailand* 23:23-34.

Pholpunthin, P. and Chittapun, S. 1998. Freshwater Rotifera of the genus *Lecane* from Songkhla Province, southern Thailand. *Hydrobiologia* 387/388:23-26.

Ryding, S.-O. and Rast, W. 1989. *The contral of eutrophication of lakes and reservoirs* (Vol.1). 314 pp. Paris: The Parthenon Publishing.

Ruppert, E. E. and Barnes, R. D. 1994. *Invertebrate Zoology* (6th ed.), 1056 pp. Forth Worth: Harcourt College Publisher.

Sanoamuang, L. 1996. *Lecane segersi* n. sp. (Rotifera, Lecanidae) from Thailand. *Hydrobiologia* 339:23-25.

Sanoamuang, L.. 1998. Rotifera of some freshwater habitats in the floodplain of the River Nan, northern Thailand. *Hydrobiologia* 387/388: 27-33.

Sanoamuang, L, Segers, H. and Dumont, H. J. 1995. Additions to the rotifer fauna of south-east Asia: new and rare species from north-east Thailand. *Hydrobiologia* 313/314: 35-45.

Sanoamuang, L. and Segers, H. 1997. Additions to the *Lecane* Fauna (Rotifera: Monogononta) of Thailand. *Int. Revue ges. Hydrobiol.* 82: 525-530.

Sanoamuang, L. and Savatenalintion, S. 1999. New records of rotifers from Nakhon Ratchasima province, northeast Thailand, with a description of *Lecane baimaii* n. sp. *Hydrobiologia* 412:95-101.

Sanoamuang, L. and Savatenalintion, S. 2001. The rotifer fauna of Lake Kud-Thing, a shallow lake in Nong Khai Province, northeast Thailand. *Hydrobiologia* 446/447:297-304.

Segers, H. 1995-1996. Introduction to the practice of identifying Rotifera. International Training course. Universiteit Gent. 69 pp.

Segers, H. and Chittapun, S. 2001. The interstitial Rotifera of a tropical freshwater peat swamp on Phuket Island, Thailand. *Belg. J. Zool.* 131(2):25-31.

Segers and Pholpunthin, 1997. New and rare Rotifera from Thale-Noi Lake, Pattalang Province, Thailand, with a note on the taxonomy of *Cephalodella* (Notommatidae). *Annls Limnol.* 33(1):13-21.

Segers, H. and Sanoamuang, L. 1994. Two more new species of *Lecane* (Rotifera, Monogononta) from Thailand. *Belg. J. Zool.* 124(1):39-46.

Solomon, E.P., Berg, L.R. and Martin, D.W. 2002. *Biology* (6^{th} ed.), 1254 pp. Australia: Brooks/Cole.

WWW sites

Thai peat swamp information:

http://www.wildlifefund.or.th/07_Habitats/03_peatswam_forest/peatswam_forest00.html

http://www.zyworld.com/NAKARIN/HTMLbirdhabitat.htm#peat

Estimates Program for randomization:

http://viceroy.eeb.uconn.edu/estimates

PUBLICATIONS

Chittapun, S., Pholpunthin, P. and Segers, H. 1999. Rotifera from peat-swamps in Phuket province, Thailand, with the description of a new *Colurella* BORY DE ST. VINCENT. *Internat. Rev. Hydrobiol.* 84(6):587-593.

Chittapun, S. and Pholpunthn, P. 2001. The rotifer fauna of peat-swamps in southern Thailand. *Hydrobiologia* 446/447:255-259.

Chittapun, S., Pholpunthin, P. and Segers, H. 2002. Rotifer diversity in a peat-swamp in southern Thailand (Narathiwas province) with the description of a new species of *Keratella* Bory de St. Vincent. *Ann. Limnol.* 38(3):185-190.

Chittapun, S., Pholpunthin, P. and Segers, H. 2003. Contribution to the knowledge of Thai microfauna diversity: notes on rare peat swamp Rotifera, with the description of a new *Lecane* Nitzsch, 1872. *Hydrobiologia* 501: 7-12.

Chittapun, S., Pholpunthin, P. and Segers, H. Restoration of tropical peat swamp rotifer communities after perturbation: An experimental study of recovery of rotifers from the resting egg bank. (accepted).

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Rotifera from Peat-Swamps in Phuket Province, Thailand, with the Description of a New *Colurella* BORY DE ST. VINCENT

key words: rotifera, Thailand, zoogeography, taxonomy, *Colurella*, new species.

Abstract

The rotifer fauna of three peat-swamps in Phuket province, southern Thailand was investigated. A total of 77 species is identified, 12 of which are new to Thailand. A new species, *Colurella sanoamuangae* n. sp., is described. The zoogeography of the registered species is discussed.

1. Introduction

Although the Thai rotifer fauna has been extensively investigated recently (SANOAMUANG, 1996; SANOAMUANG *et al.*, 1995; SEGERS and PHOLPUNTHIN, 1997; SEGERS and SANOAMUANG, 1994), many habitat types have not been considered yet. One of such types is peat-swamp forest, which is an important wetland habitat in Thailand. Water in these peat-swamps is characterized by its brownish color and high acidity, and these habitats are inhabited by a fairly diverse rotifer fauna. In order to document this community, and to contribute to the knowledge of Thai rotifers, we studied the rotifers from three peat-swamps (Mai-khao, Jood ans Jik) in Phuket province, Thailand. We here report on the composition of the rotifer fauna of the swamps, and describe a new species that was found during the study.

2. Material and Methods

Samples were collected in the littoral zone of three peat-swamps (Mai-khao, Jood and Jik peak-swamps) in Phuket province, Thailand on July 7, 1998 (Fig. 1). The samples were taken by several horizontal hauls using a 26 µm plankton net, and immediately preserved in 4% formaldehyde solution. Specimens were sorted under an Olympus VM dissecting microscope, and examined and drawn using an Olympus CH-2 attached with a camera lucida. Some specimens were prepared for scanning electron microscopy by placing the specimens on a nucleopore membrane, which was subsequently placed in a stainless steel case. Specimens were dried by dehydration using graded ethanol, and subsequent critical-point drying. The dried specimens were then mounted on a metal specimen stub (diameter 10 mm, height 5 mm) using a double-sided adhesive tape and coated with gold, and observed using a JEOL 5800LV scanning electron microscope. All measurements are in µm.

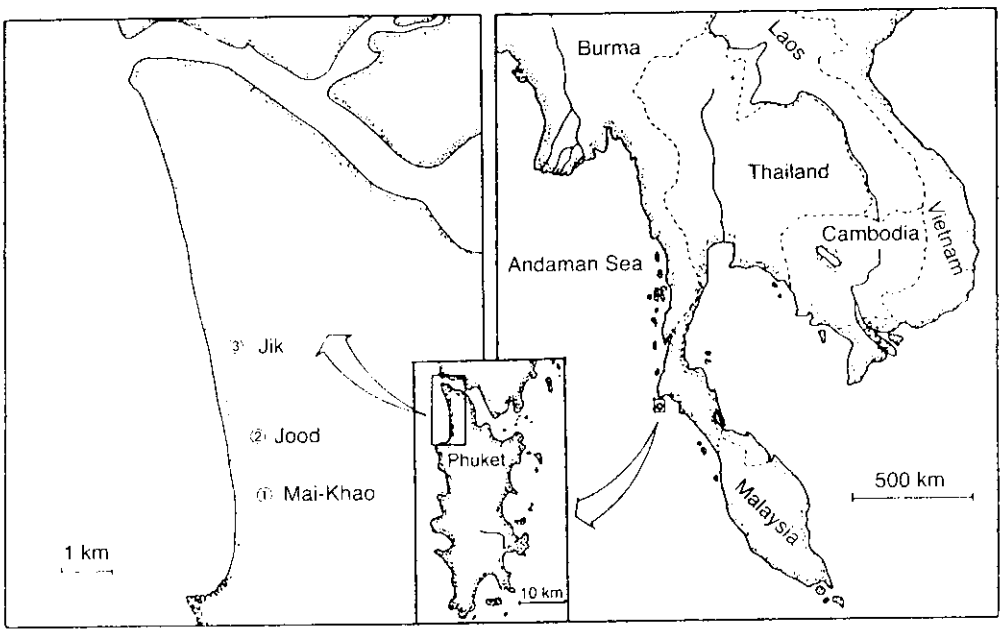


Figure 1. Map of Thailand showing the location of Phuket province and the peat-swamp areas.

3. Results and Discussion

A total of 77 species of monogont Rotifera was identified. Twelve of these are new to Thailand, one is new to science (Table 1). The samples contained many contracted Bdelloidea, which were deformed beyond identification. A description of the new species is as follows.

Family Colurellidae

Colurella sanoamuangae n. sp. (Figs. 2–4, 7–8)

Type locality

Littoral of Mai-khao peat-swamp, Phuket province, Thailand on July 7, 1998. Other locality: Thale-noi lake, Pattalung province, Thailand on September 16, 1995.

Material examined

Holotype and one paratype in Natural History Museum, Prince of Songkla University (PSU), Thailand, one paratype in Plankton Research Unit, PSU (PRU 1), the Belgian Institute for National Sciences (KBIN) and the Science Museum, Khon Kaen University, each. More specimens were present in the original sample (in PSU) from the type locality.

Differential diagnosis

The new species resembles *C. colurus* (EHRENBERG) and *C. adriatica* EHRENBERG. It can be distinguished from these by its relatively large size, but especially by its peculiar head

Table 1. List of the Rotifera from peat-swamps in Phuket province

Anuraeopsis fissa (GOSSE): 1, 2
A. navicula (ROUSSELET): 2
Brachionus angularis GOSSE
B. falcatus ZACHARIAS: 2
B. quadridentatus HERMAN: 1, 2, 3
B. rubens EHRENBERG: 1
**B. variabilis* (HEMPEL): 1
***Cephalodella* cf. *hyalina* MYERS: 3
***C. innesi* MYERS: 1, 2
Colurella colurus (EHRENBERG): 1
C. obtusa (GOSSE): 1, 2
***C. sanoamuangae* **new species**: 1, 2
Dicranophorus epicharis HARRING & MYERS: 1
Euchanis dilatata EHRENBERG: 2, 3
E. incisa CARLIN f. *mucronata* AHLSTROM: 1, 2, 3
***E. lyra* HUDSON f. *myersi* KUTIKOVA: 3
E. meneta MYERS: 3
Filinia longiseta (EHRENBERG): 2
F. novaezaelandiae SHIEL & SANOAMUANG: 2
F. opoliensis (ZACHARIAS): 2
Keratella tropica (APSTEIN): 1, 2
Lecane aculeata (JAKUBSKI): 1, 2
L. arcuata (BRYCE): 3
L. arcula HARRING: 1, 3
L. bifurca (BRYCE): 3
L. bulla (GOSSE): 1, 2, 3
L. closterocerca (SCHMARDA): 1, 2, 3
L. crepida HARRING: 1, 2, 3
**L. decipiens* (MURRAY): 1, 2, 3
L. flexilis (GOSSE): 2
L. furcata (MURRAY): 1, 3
**L. grandis* (MURRAY): 1
L. hamata (STOKES): 1, 2, 3
L. inermis (BRYCE): 1, 3
L. inopinata HARRING & MYERS: 1, 3
L. leontina (TURNER): 2, 3
L. ludwigii (ECKSTEIN): 1, 2
L. luna (MÜLLER): 1, 3
L. lunaris (EHRENBERG): 1, 2
L. monostyla (DADAY): 3
L. obtusa (MURRAY): 1, 2, 3
L. papuana (MURRAY): 1, 2, 3
L. pyriformis (DADAY): 1, 2, 3
L. quadridentata (EHRENBERG): 2
L. rhytida HARRING & MYERS: 1, 2
L. signifera (JENNINGS): 2, 3
L. shieli SEGERS & SANOAMUANG: 2
L. stenroosi (MEISSNER): 1
L. temuiseta HARRING: 1
L. unguitata HAUER: 1, 2, 3
L. unguitata (FADEEV): 2
L. ungulata (GOSSE): 2
Lepadella acuminata (EHRENBERG): 3
L. apsida HARRING: 1
L. discoidea SEGERS: 3
L. ovalis (MÜLLER): 3
L. patella (MÜLLER): 1, 2, 3
L. quadricarinata (STENROOS): 2
L. rhomboides (GOSSE): 1, 2
L. triba MYERS: 3
Macrochaetus collinsi (GOSSE): 2, 3
**Monommata grandis* TESSIN: 1, 2, 3
***M. longiseta* (MÜLLER): 1, 2, 3
Mytilina ventralis (EHRENBERG): 1
***Notommata pygmaea* HARRING & MYERS: 3
Platiomus patulus (MÜLLER): 2, 3
Platyias quadricornis (EHRENBERG): 3
Polyarthra minor VOIGT: 1, 2, 3
P. vulgaris CARLIN: 1, 2
Scaridium longicaudum (MÜLLER): 3
***Squatinella leydigii* (ZACHARIAS) f. *longiseta* (POURRIOT): 2
**Taphrocampa annulosa* GOSSE: 1, 2
Testudinella patina (ZACHARIAS): 2, 3
Trichocerca braziliensis MURRAY: 1, 3
T. insulana (HAUER): 3
T. pusilla (LAUTERBORN): 2
T. similis (WIERZEJSKI): 1, 2

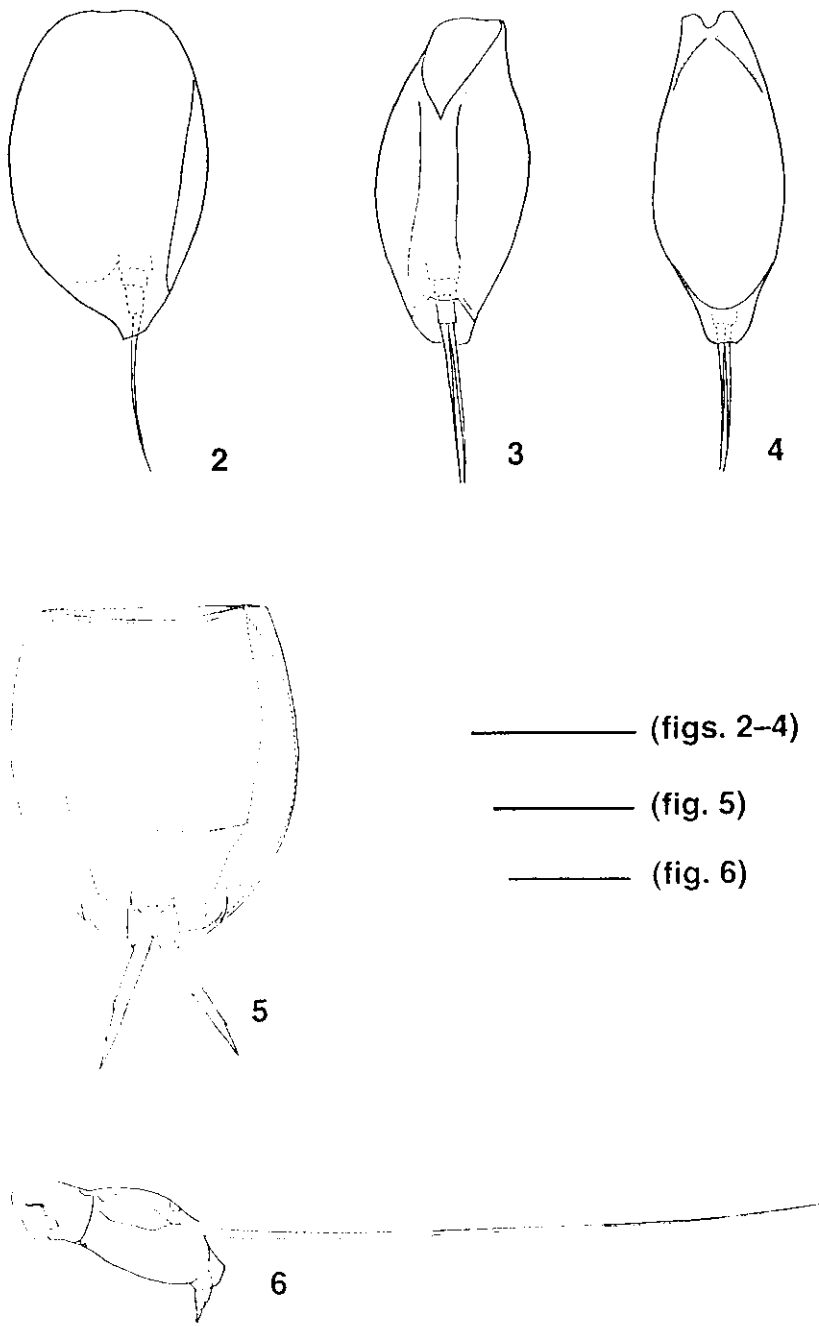
* New to Thailand.
** New to the Oriental region.

Numbers refer to localities as in Figure 1.

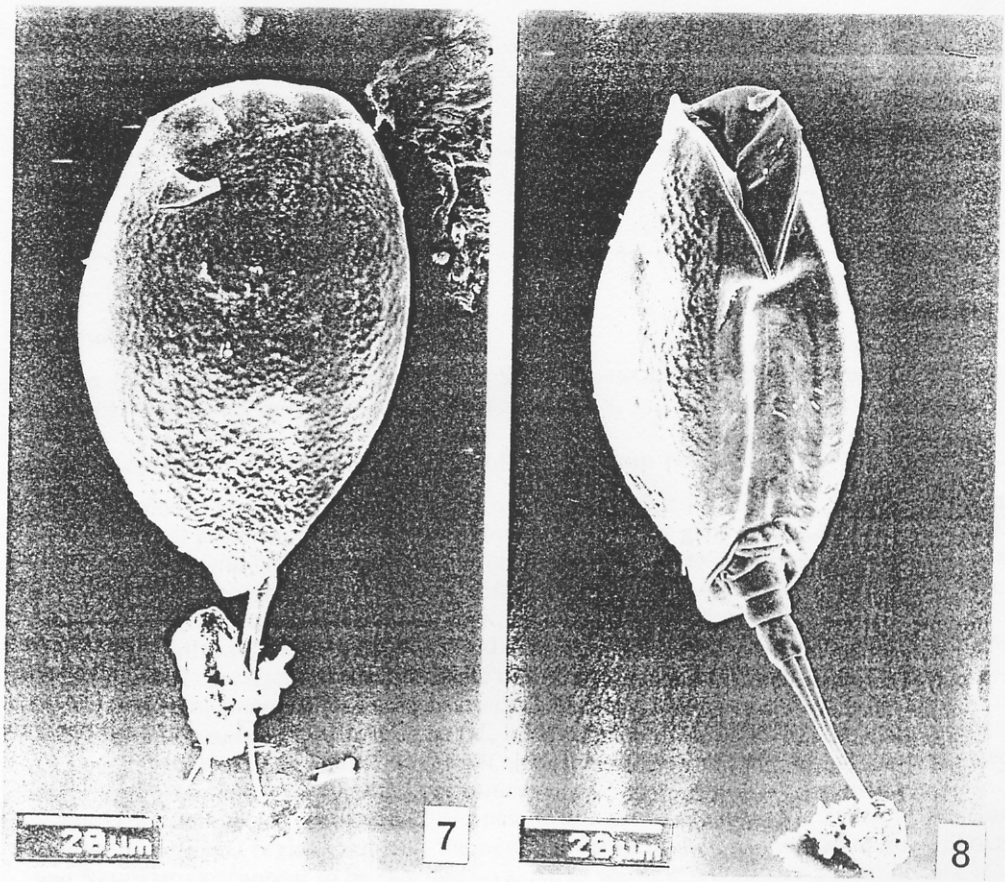
aperture margins having a small concavity midlaterally. The peculiar caudal projection overlaying the foot is unique to *C. sanoamuangae* n. sp.; in *C. colurus*, no separate caudal projection is present, whereas in *C. adriatica* there is a pair of triangular posteriorly projections extending from the postero-lateral margins of the lorica plates, laterally of the foot.

Description

Parthenogenetic female: Body ellipsoidal in dorsal, oval in lateral view. Lorica three times as long as wide, about one and a half time as high as wide. Head aperture margins rounded, with median concavity in lateral view; dorsally a small U-shaped sinus, ventrally a deep



Figures 2–4. *Coelastrella samoaensis* n. sp. – 2: lateral view, 3: ventral view, 4: dorsal view. Scale bar = 50 µm.
Figure 5. *Lecane grandis* (MURRAY). – ventral view. Scale bar = 50 µm.
Figure 6. *Squatinella leydigii* (ZACHARIAS). f. *longiseta* (POURRIOT). – lateral view. Scale bar = 50 µm.



Figures 7–8. *Colurella sanoamuangae* n. sp. SEM photographs. – 7: lateral view, 8: ventro-lateral view.

V-shaped sinus in anterior view. Dorsal and ventral margins smoothly curved. Posterior end of lorica with, in lateral view, slightly projecting, triangular tip; in ventral or dorsal view this projection is a small, tongue-shaped projection over the foot aperture. Ventral sulcus deep. Foot with three pseudosegments, the distal one about twice the length of the basal or median one. Toes relatively long, weakly curved ventrally, smoothly tapering to an acute point distally. Male unknown.

Measurements: Lorica length 98–102 µm, heigh 66–72 µm, last foot pseudosegment length 8–10 µm, toe length 44–48 µm (n = 6).

Distribution and Ecology

A single specimen of *C. sanoamuangae* n. sp. was found in Thale-noi lake, Thailand (Fig. 1 *in* SEGERS and PHOLPUNTHIN 1997). During the present study, the species was found in Mai-khao peat-swamp only; at the time of sampling, water temperature was 28.1–29.3 °C, pH 5.6–5.9, the concentration of dissolved oxygen was 3.35–4.25 mg · l^{-1}, conductivity was 1.98–2.90 mS · cm^{-1}, and turbidity 4–18 NTU. A list of the accompanying rotifer fauna is as in Table 2.

Table 2. Some physical and chemical variables of the sampled peat-swamps

Swamp:	water temp. (°C)	pH	diss. O_2 ($mg \cdot l^{-1}$)	conduct. ($mS \cdot cm^{-1}$)	turbidity (NTU)
Mai-Khao	28.1–29.3	5.6–5.9	3.35–4.25	1.98–2.90	4–18
Jood	28.2–28.5	5.6	3.05–4.35	0.78–0.82	4–7
Jik	30.3	5.9	4.15	0.63	6

Etymology

The species is named after Dr. LA-ORSRI SANOAMUANG (Khon Kaen University; Thailand) in recognition of her contribution to Thai rotiferology.

Species composition and zoogeography of peat-swamp rotifers

As mentioned above, 77 rotifer species were identified from the three peat-swamps sampled in Phuket province, Thailand. The most diverse rotifer genus was *Lecane* (40.3%), followed by *Lepadella* (10.4%) and *Brachionus* (6.5%). These results agree well with existing knowledge on the composition of the rotifer fauna of Thale-noi Lake, Pattalung province (South Thailand: SEGERS and PHOLPUNTHIN, 1997) and Nam Pung reservoir, Sakon Nakhon province (North-east Thailand: SEGERS and SANOAMUANG, 1994). Such assemblage appears to be a general characteristic of the rotifer faunas of soft, tropical waters (e.g. DUSSART *et al.*, 1984). The most frequently encountered individual rotifer species were *Brachionus quadridentatus* HERMAN, *Lecane bulla* (GOSSE), *L. closterocerca* (SCHMARDA), *L. hamata* (STOKES), *L. obtusa* (MURRAY), *Lepadella patella* (MÜLLER) and *Polyarthra minor* VOIGT. All these are fairly common rotifers in tropical environments.

Of 77 rotifer species recorded, 12 are new to the fauna of Thailand. Seven of these are new to the Oriental region, and two, the new species described herein and *L. shieli* SEGERS and SANOAMUANG, appear to be endemic taxa. All of the new records are littoral-benthic rotifers, once again demonstrating the high diversity, and lack of study of such habitats. Many of the new records (*Cephalodella* cf. *hyalina* MYERS, *C. innesi* MYERS, *Monommata grandis* TESSIN, *M. longiseta* (MÜLLER), *Notommata pygmaea* HARRING and MYERS and *Taphrocampa annulosa* (Gosse) concern illoricate taxa. The identification of these is particularly difficult and they are rarely found in large numbers, which may account for their scarcity and their absence in previous collections from the Oriental region and/or Thailand. The occurrence of some of them (*Cephalodella* cf. *hyalina*, *C. innesi* and *Notommata pygmaea*) may also be due to the fact that they are acidophylic, inhabiting a type of habitat which only occasionally attracts the attention of researchers. Others, like *Brachionus variabilis* (HEMPEL), *Euchlanis lyra* HUDSON f. *myersi* KUTIKOVA and *Lecane decipiens* (MURRAY) are widespread but relatively infrequent rotifers species. A peculiar record is that of *Lecane grandis* (MURRAY) (Fig. 5), which is a cosmopolitan species inhabiting saline waters (SEGERS 1995a, b). Its occurrence in the present collection may be due to the location of the study areas, near the Andaman Sea. *Squatinella leydigii* (ZACHARIAS) f. *longiseta* (POURRIOT) (Fig. 6) is a noticeably rare but cosmopolitan species (see DE RIDDER and SEGERS, 1997; JOS DE PAGGI, 1996), that inhabits acid waters (KOSTE, 1978; KOSTE and SHIEL, 1989).

The results presented here demonstrate that, notwithstanding the recent research effort towards the Thai rotifer fauna, still much remains to be discovered, especially regarding littoral-benthonic and illoricate Rotifera. Also, all of the new records are littoral-benthic rotifers, while some of the illoricate species and *Squatinella leydigii* are restricted to soft, (moderately) acid waters connected to peat-swamps. This illustrates that such habitats should be more adequately covered in biodiversity inventories.

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5. References

BRAIONI, M. G. and D. GELMINI, 1983: Rotatoria: Monogononta. Guide per il Riconoscimento delle Species Aminali delle Acque Interne Italiane. Consiglio Nazionale delle Ricerche, Italy, 179 pp.

DE RIDDER, M. and H. SEGERS, 1997: Rotifera Monogononta in six zoogeographical regions after publications between 1960–1992. – Studiedocumenten van het Koninklijk Belgisch Instituut voor Natuurwetenschappen (J. Van Goethem ed.), 481 pp.

DUSSART, C. G., C. H. FERNANDO, T. MATSUMURA-TUNDISI and R. J. SHIEL, 1984 : A review of systematics, distribution and ecology of tropical freshwater zooplankton. – Hydrobiologia, **113**: 77–91.

JOS DE PAGGI, S., 1996: Rotifera (Monogononta) diversity in subtropical waters of Argentina. – Annls Limnol. **32** (4): 209–220.

KOSTE, W., 1978: Rotatoria. Die Rädertiere Mitteleuropas. Borntraeger, Berlin, 2 Vols: 673 pp, 234 plates.

KOSTE, W. and R. J. SHIEL, 1989: Rotifera from Australian Inland Waters IV. Colurellidae (Rotifera: Monogononta). – Transactions of the Royal Society of S. Aust., **113**: 119–143.

NOGRADY, T., R. POURRIOT and H. SEGERS, 1995: Rotifera. Vol. 3: The Notommatidae and the Scaridiidae. Guides to the identification of the Microinvertebrates of the Continental Waters of the World 8. SPB Academic Publishing bv, The Hague, The Netherlands, 248 pp.

SANOAMUANG, L., 1996: *Lecane segersi* n. sp. (Rotifera, Lecanidae) from Thailand. – Hydrobiologia, **339**: 23–25.

SANOAMUANG, L., H. SEGERS and H. J. DUMONT, 1995: Additions to the rotifer fauna of south-east Asia: new and rare species from north-east Thailand. – Hydrobiologia **313/314**: 35–45.

SEGERS, H., 1995a: Rotifera. Vol. 2: The Lecanidae (Monogononta). Guides to the identification of the Microinvertebrates of the Continental Waters of the World 6. SPB Academic Publishing bv, The Hague, The Netherlands, 226 pp.

SEGERS, H., 1995b: World records of Lecanidae (Rotifera: Monogononta). – Studiedocumenten van het Koninklijk Belgisch Instituut voor Natuurwetenschappen (J. Van Goethem ed.) **81**: 114 pp.

SEGERS, H. and P. PHOLPUNTHIN, 1997: New and rare Rotifera from Thale-Noi Lake, Pattalung province, Thailand, with a note on the taxonomy of *Cephalodella* (Notommatidae). – Annals. Limnol. **33**: 13–21.

SEGERS, H. and L. SANOAMUANG, 1994: Two more new species of *Lecane* (Rotifera, Monogononta) from Thailand. – Belg. J. Zool. **124**: 39–46.

SEGERS, H. and L. SANOAMUANG, 1997: Additions to the *Lecane* Fauna (Rotifera: Monogononta) of Thailand. – Int. Revue ges. Hydrobiol. **82**: 525–530.

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L. Sanoamuang, H. Segers, R.J. Shiel & R.D. Gulati (eds), Rotifera IX.

The rotifer fauna of peat-swamps in southern Thailand

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Key words: Rotifera, peat-swamps, Thailand

Abstract

The Rotifera from four peat-swamps in the provinces Suratthanee (Kra-Jood and Kun-Thu-Lee peat-swamps), Nakhonsri-thammarat (Khuan-Kreng peat-swamp) and Yala (Lan-Kway peat-swamp) in southern Thailand were examined by the study of qualitative samples collected on three occasions during July, October and November, 1998. A total of 96 species was identified, seventeen of which are new to the Thai rotifer fauna. The most diverse genera were *Lecane* (40.6%), followed by *Lepadella* (8.3%) and *Trichocerca* (7.3%). The most diverse rotifer fauna was found in Kra-Jood peat-swamp (61 species), followed by Kun-Thu-Lee (57 species), Lan-Kway (41 species) and Khuan-Kreng (24 species) peat-swamps, respectively.

Introduction

In recent years, the number of studies on Thai Rotifera has increased steadily (Segers & Sanoamuang, 1994, 1997; Sanoamuang et al., 1995; Sanoamuang 1996, 1998; Pholpunthin, 1997; Segers & Pholpunthin, 1997; Sanoamuang & Segers, 1997; Sanoamuang & Savatenalinton, 1999). Most of the studies sampled canals, rivers, ponds, rice fields or reservoirs, but peat-swamps, an important wetland habitat in Thailand, have largely been ignored. The formation of these peat-swamps, by the accumulation of dead plant material and debris, has taken thousands of years. The vegetation of the peat-swamps depends on the peaty soil and on the fluctuation of the water levels. This water is acid and brownish (Phengklai et al., 1989). A previous study on Rotifera from Phuket peat-swamps reported 77 species, including 12 new records for Thailand, and a new species, *Colurella sanoamuangae* was described (Chittapun et al., 1999). This result illustrates that peat-swamps are interesting areas for the study of rotifer biodiversity. The purpose of the present study is to expand our knowledge of the rotifers inhabiting peat-swamps, by investigating four peat-swamps in southern Thailand.

Materials and methods

Samples were collected qualitatively in four peat-swamps (Kra-Jood and Kun-Thu-Lee peat-swamps, Suratthanee province; Khuan-Kreng peat-swamp, Nakhornsri-thammarat province and Lan-Kway peat-swamp, Yala province, Southern Thailand (Fig. 1) on three occasions in July, October and November, 1998. Some physical and chemical parameters of the peat-swamps are as in Table 1. The samples consist of several horizontal hauls made using a 26-μm plankton net, which were immediately preserved in 4% formaldehyde solution. Specimens were sorted under an Olympus VM dissecting microscope. They were examined and drawn using an Olympus CH-2 compound microscope with camera lucida. Some specimens were prepared for scanning electron microscopy as described by Chittapun et al. (1999).

Results and discussion

Ninety-six rotifer species, 17 of which are new to the Thai fauna, were identified from the four peat-swamps studied (Table 2). Of the 17 new records, two: *Lecane*

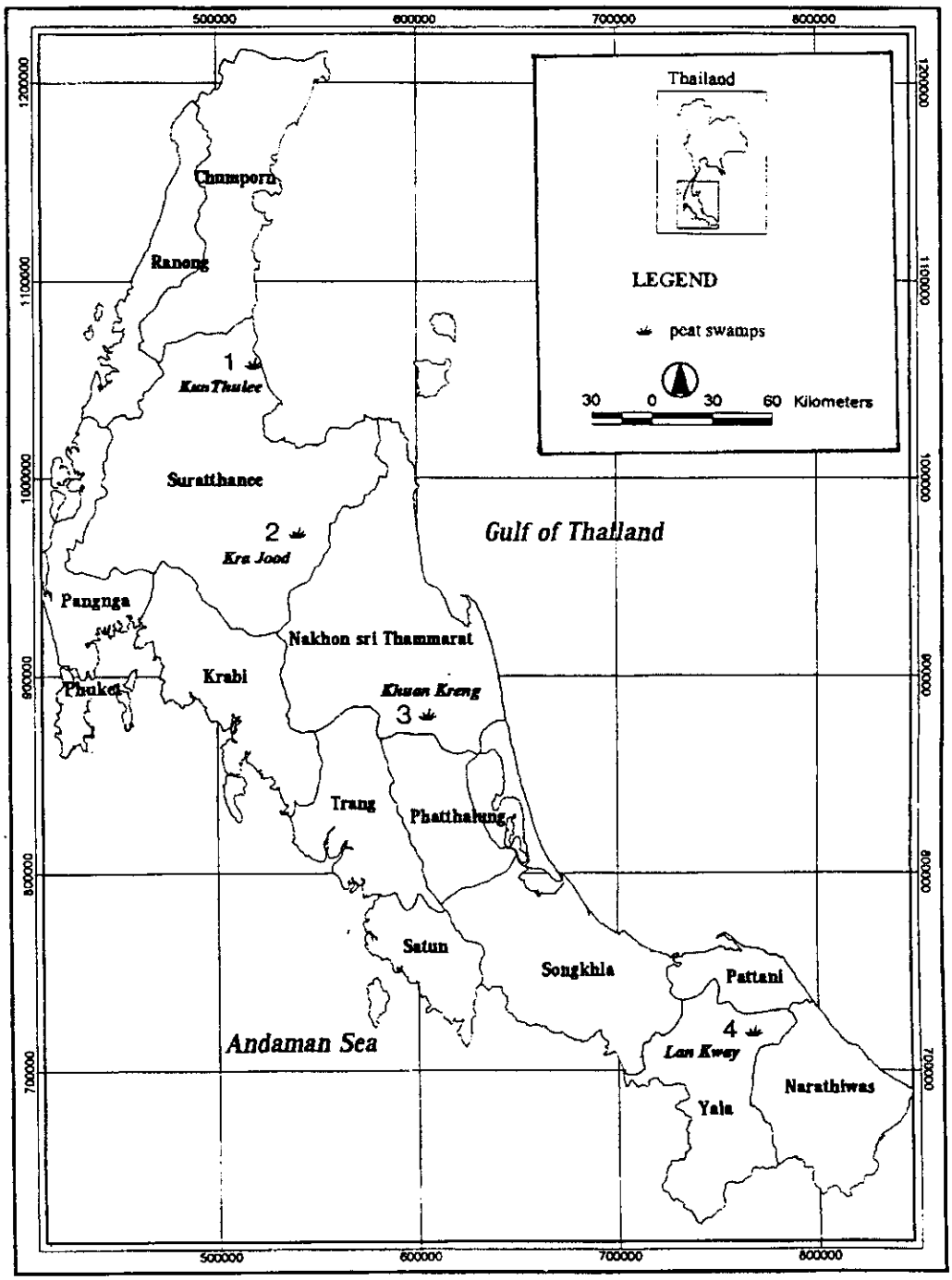
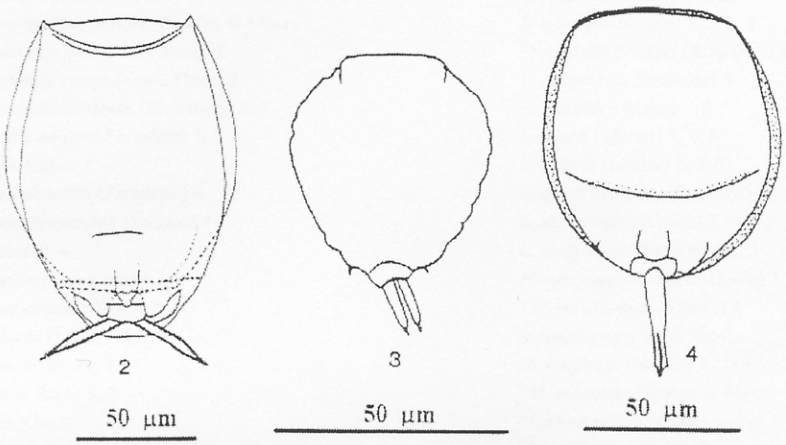
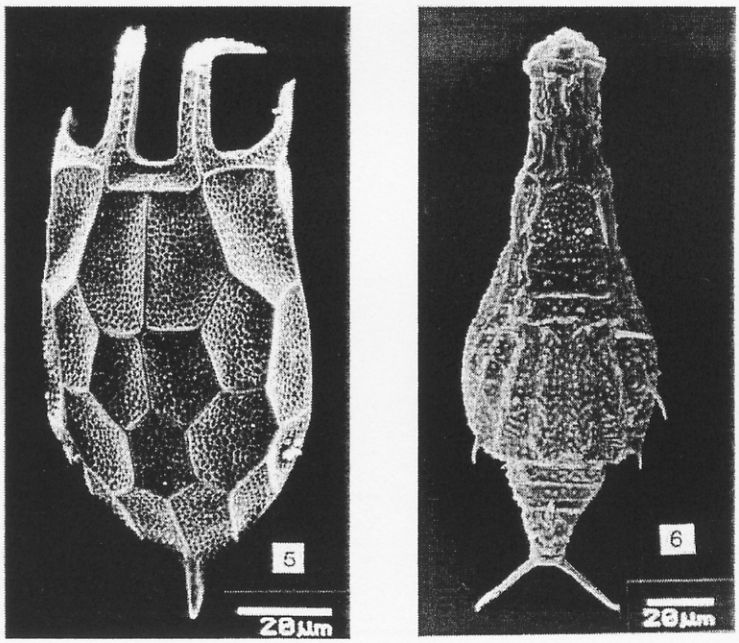


Figure 1. Map of Thailand showing the location of the southern part and the peat swamp areas.

Table 1. Physical and chemical parameters of the sampled peat-swamps

Swamp	Water temp. (°C)	pH	Diss. O_2 (mg l^{-1})	Conduct. (mS cm^{-1})	Turbidity (NTU)
Kun Thulee	25.7–26.6	4.93–5.37	2.27–4.30	0.03	11.0–12.0
Kra Jood	25.8–27.2	5.59–5.98	2.30–7.88	0.03	11.0–43.0
Khuan Kreng	27.2–30.1	5.20–7.14	5.60–7.40	0.04–0.07	11.0–69.0
Lan Kway	29.3–30.8	6.01–6.37	4.46–5.65	0.02	14.0–54.0





Figures 2–6. (2) *Lecane mitis* (Harring & Myers) – ventral view. (3) *Lecane palinacis* Harring & Myers – ventral view. (4) *Lecane syngenes* (Hauer) – ventral view. (5) *Keratella javana* (Hauer) SEM photograph – dorsal view. (6) *Dissotrocha aculeata* (Ehrenberg) SEM photograph – dorsal view.

Table 2. List of Rotifera from peat-swamps in Southern Thailand * New to Thailand; Numbers refer to localities as in Figure 1

Anuraeopsis fissa (Gosse) 1, 2, 3, 4
Ascomorpha sp. 4
Brachionus quadridentatus f. *mirabilis* (Daday) 2, 4
**Cephalodella mucronata* Myers 2
Colurella adriatica Ehrenberg 4
C. colurus (Ehrenberg) 3
C. obtusa (Gosse) 4
**C. sulcata* (Stenroos) 1, 2
**C. tesselata* (Glascott) 1, 2
C. uncinata (Müller) 1, 2, 3, 4
Dicranophorus epicharis Harring & Myers 1
Dipleuchanis propatula (Gosse) 1
D. propatula macrodactyla Hauer 2
**Dissotrocha aculeata* (Ehrenberg) 2, 3
Euchlanis dilatata Ehrenberg 1, 2
E. incisa Carlin 1
Filinia opoliensis (Zacharias) 4
Floscularia conifera (Hudson) 1
Hexathra sp. 4
**Keratella javana* Hauer 1, 2
**Lecane abanica* Segers 1
L. aculeata (Jakubski) 2
L. arcuata (Bryce) 1
L. braumi Koste 2, 3
L. bulla (Gosse) 1, 2, 3, 4
L. calcaria Harring & Myers 1
L. clara (Bryce) 1, 2
L. closterocerca (Schmarda) 1, 2
L. crepida Harring 4
L. curvicornis (Murray) 1, 2
L. decipiens (Murray) 3
L. doryssa Harring 1, 2, 4
L. furcata (Murray) 2, 4
L. haliclysta Harring & Myers 1, 2
L. hamata (Stokes) 1, 2, 3, 4
L. hornemanni (Ehrenberg) 1, 2
L. inermis (Bryce) 1, 3, 4
L. inopinata Harring &Myers 1, 2
L. leontina (Turner) 1, 2, 3, 4
L. ludwigii (Eckstein) 1, 2, 4
L. lunaris (Ehrenberg) 1, 2, 3, 4
**L. mitis* (Harring & Myers) 3
L. monostyla (Daday) 1, 2, 3
L. obtusa (Muray) 2, 3
**L. palinacis* Harring & Myers 1
L. papauna (Murray) 3
L. pertica Harring & Myers 1, 2, 3, 4
L. pusilla Harring 4
L. pyriformis (Daday) 1, 2, 4
L. quadridentata (Ehrenberg) 1, 2
L. rhytida Harring & Myers 1
L. signifera (Jennings) 1, 2, 3, 4
**L. simonneae* Segers 3
**L. syngenes* (Hauer) 1
L. tenuiseta Harring 2, 4
L. thienemanni Hauer 2
L. undulata Hauer 1
L. unguitata (Fadeev) 1, 2, 4
L. ungulata (Gosse) 1, 2, 3, 4
**Lepadella cristata* (Rousselet) 1, 2
L. dactyliseta (Stenroos) 4
L. discoidea Segers 1, 2
L. ovalis (Müller) 1, 2, 4
L. patella (Müller) 1, 2, 3
L. quadricarinata (Stenroos) 2
L. rhomboides (Gosse) 3
L. vandenbrandei Gillard 1, 2
Macrochaetus collinsi (Gosse) 1, 2, 4
**M. subquadratus* (Perty) 4
Monommata grandis Tessin 2
M. longiseta (Müller) 2
**M. maculata* Harring & Myers 1, 2
Mytilina ventralis (Ehrenberg) 1, 2
Notommata pachyura f. *spinosa* Koste 2, 4
**N. saccigera* Ehrenberg 1
Plationus patulus (Müller) 1, 2, 4
Polyarthra vulgaris Carlin 2, 4
Scaridium elegans Segers & De Meester 2
S. grande Segers 1, 2
S. longicaudum (Müller) 2, 4
Squatinella mutica (Ehrenberg) 4
Testudinella amphora Hauer 1, 4
T. incisa ahlstromi (Hauer) 1, 2, 4
**T. mucronata* (Gosse) 4
T. parva (Ternetz) 1, 2
T. patina (Hermann) 1, 2, 3, 4
T. tridentata Smirnov 1, 2
**Tetrasiphon hydrocora* Ehrenberg 4
Trichocerca brasiliensis (Murray) 4
**T. collaris* (Rousselet) 2
T. flagellata Hauer 2
T. hollaerti De Smet 1, 2
T. insignis (Herrick) 1
T. similis grandis Hauer 2, 3, 4
T. tropis Hauer 1
Trichotria tetractis (Ehrenberg) 1, 2, 3, 4

mitis (Harring & Myers) and *L. palinacis* Harring & Myers are new to the Oriental Region. The former species (Fig. 2) has been found in the Nearctic and Neotropical Regions, while the latter (Fig. 3) has been recorded from the U.S.A. and the Galapagos Islands (Segers, 1995; Segers & Dumont, 1995; De Ridder & Segers, 1997). Many of the new records (*Cephalodella mucronata* Myers, *Colurella sulcata* (Stenroos), *C. tesselata* (Glascott), *Keratella javana* Hauer, *Lecane syngenes* (Hauer), *Macrochaetus subquadratus* (Perty), *Notommata saccigera* Ehrenberg, *Tetrasiphon hydrocora* Ehrenberg and *Trichocerca collaris* (Rousselet)) are widely distributed in the Oriental Region, occurring in Indonesia, Malaysia, Singapore and Sri Lanka (De Ridder & Segers, 1997). Among them, *K. javana* (Fig. 5) and *N. saccigera* are cosmopolitan species, common in acid waters (Sudzuki, 1991; Nogrady & Pourriot, 1995), while *L. syngenes* (Fig. 4) is a rare, warm-stenothermic Pan(sub)tropical species (Segers, 1995). The rest of the new records, *Dissotrocha aculeata* (Ehrenberg), *Lecane abanica* Segers, *L. simonneae* Segers, *Lepadella cristata* (Rousselet), *Monommata maculata* Harring & Myers and *Testudinella mucronata* (Gosse), are new to Southeast Asia. However, *D. aculeata* (Fig. 6) is thought to be a cosmopolitan species (Koste & Shiel, 1986).

Of the 96 taxa, the most diverse genera were *Lecane* (40.6%), followed by *Lepadella* (8.3%) and *Trichocerca* (7.3%). These results, together with the most frequently encountered rotifer species in all peat-swamps agree well with the existing knowledge on the composition of the rotifer fauna of Phuket peat-swamps (Chittapun et al., 1999). Kra-Jood peat-swamp contained the most diverse rotifer taxocoenosis (61 species) followed by Kun-Thu-Lee (57 species), Lan-Kway (41 species) and Khuan-Kreng (24 species) peat-swamps, respectively.

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References

Chittapun, S., P. Pholpunthin & H. Segers, 1999. Rotifera from peat-swamps in Phuket Province, Thailand, with the description of a new *Colurella* Bory de St. Vincent. Int. Rev. Hydrobiol. 84: 587–593.

De Ridder, M. & H. Segers, 1997. Monogonont Rotifera recorded in the World literature (except Africa) from 1960 to 1992. Studiedocumenten Van Het K.B.I.N., Documents de Travail De L'I.R.Sc.N.B., Belgium: 481 pp.

Koste, W. & J. Shiel, 1986. Rotifera from Australian inland waters. I. Bdelloidea (Rotifera : Digononta). Aust. J. Mar. Freshw. Res. 37: 765–792

Nogrady, T. & R. Pourriot, 1995. Rotifera. Vol 3 : The Notommatidae and The Scaridiidae. Guides to the Identification of the Microinvertebrates of the Continental Waters of the World 8. SPB Academic Publishing, The Hague, The Netherlands: 248 pp.

Phengklai, C., C. Niyomdham, A. Premrasmi, K. Chirathanakorn & R. Phuma, 1989. Peat swamp forest of Thailand. Thai For. Bull. 18: 1–42.

Pholpunthin, P., 1997. Freshwater zooplankton (Rotifera, Cladocera and Copepoda) from Thale-noi, south Thailand. J. Sci. Soc. Thailand 23: 23–34.

Sanoamuang, L., 1996. *Lecane segersi* n. sp. (Rotifera, Lecanidae) from Thailand. Hydrobiologia 339: 23–25.

Sanoamuang, L., 1998. Rotifera of some freshwater habitats in the floodplain of the River Nan, northern Thailand. Hydrobiologia 387/388: 27–33.

Sanoamuang, L. & S. Savatenalinton, 1999. New records of rotifers from Nakhon Ratchasima province, northeast Thailand, with a description of *Lecane baimaii* n. sp. Hydrobiologia 412: 95–101.

Sanoamuang, L. & H. Segers, 1997. Additions to the *Lecane* Fauna (Rotifera : Monogononta) of Thailand. Int. Rev. ges. Hydrobiol. 82: 525–530.

Sanoamuang, L., H. Segers & H. J. Dumont, 1995. Additions to the rotifer fauna of south-east Asia: new and rare species from north-east Thailand. Hydrobiologia 313/314: 35–45.

Segers, H., 1995. Rotifera. Vol. 2: The Lecanidae (Monogononta). Guides to the Identification of the Microinvertebrates of the Continental Waters of the World 6. SPB Academic Publishing, The Hague, The Netherlands: 226 pp.

Segers, H. & H. J. Dumont, 1995. 102+ rotifer species (Rotifera: Monogononta) in Broa reservoir (SP., Brazil) on 26 August 1994, with the description of three new species. Hydrobiologia 316: 183–197.

Segers, H. & P. Pholpunthin, 1997. New and rare Rotifera from Thale-Noi Lake, Pattalung province, Thailand, with a note on the taxonomy of *Cephalodella* (Notommatidae). Annals. Limnol. 33: 13–21.

Segers, H. & L. Sanoamuang, 1994. Two more new species of *Lecane* (Rotifera, Monogononta) from Thailand. Belg. J. Zool. 124: 39–46.

Sudzuki, M., 1991. The rotifera from Singapore and Taiwan. Proc. Jap. Soc. Syst. Zool. 43: 1–34.

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Rotifer diversity in a peat-swamp in southern Thailand (Narathiwas province) with the description of a new species of *Keratella* Bory de St. Vincent

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Keywords : rotifers, zoogeography, biodiversity, *Keratella*, new species, Thailand

We studied the rotifer fauna of one of the most pristine peat-swamps in the Southern Thai province of Narathiwas, To Daeng peat swamp. The samples yielded a total of sixty-seven rotifer species. Of these, three -*Keratella mixta* (Oparina-Charitonova), *Lecane enowi* Segers & Mertens and *Monommata dentata* Wulfert- are new to the Oriental region and the Thai fauna, one, *Keratella taksinensis* n. sp., is new to science. The fauna consists mainly of cosmopolitan (*sensu lato*) species, complemented by some Paleotropical and endemic taxa, and is dominated by littoral-benthonic taxa, especially *Lecane* and, to a lesser extent, *Lepadella*.

Diversité des rotifères dans un marais tourbeux du sud de la Thaïlande (Province de Narathiwas) avec la description d'une espèce nouvelle de *Keratella* Bory de St. Vincent

Mots-clés : rotifères, zoogéographie, biodiversité, *Keratella*, espèce nouvelle, Thaïlande.

Une étude des rotifères d'un marais tourbeux vierge dans le sud de la Thaïlande, le marais de To Daeng, a révélé un total de 67 espèces, dont trois -*Keratella mixta* (Oparina-Charitonova), *Lecane enowi* Segers & Mertens et *Monommata dentata* Wulfert- sont nouvelles pour la région Orientale et la Thaïlande. Une espèce, *Keratella taksinensis* n. sp., est nouvelle pour la science. La faune est composée en majorité d'espèces cosmopolites (*sensu lato*), accompagnées par quelques espèces paléotropicales et endémiques. Elle est dominée par des espèces littorales et benthiques, notamment des *Lecane* et, moins nombreuses, des *Lepadella*.

1. Introduction

Recently, the study of Rotifera inhabiting peat swamps in Thailand, representing the most diverse group of primary freshwater Metazoa in these peculiar tropical ecosystems, has attracted much interest (e.g., Chittapun et al. 1999, Chittapun & Pholpunthin 2001, Segers & Chittapun 2001). However, all studies to date, report on peat swamps that have been influenced, to a greater or lesser extent, by human activities such as farming. These and other disturbances have had a substantial impact on the macrophyte vegetation and on water quality, crucial to the zooplankton communities inhabiting these environments.

One of the few pristine peat swamps in Thailand is To-Daeng peat swamp in the southern province Narathiwas, and the study of its rotifer fauna may be informative about the natural biodiversity of this habitat type. Such information is required to assess the impact of human activities on tropical peat swamps. Here we report on the rotifer fauna of this peat swamp.

To Daeng peat swamp (101°55'E-102°03'E, 06°03'N-06°03'E, Fig. 1) is the largest pristine peat swamp in Thailand. It covers an area of ca. 17,352 hectares. The region has a tropical monsoon climate, with heavy rainfall from September to January, and a relatively drier period from February to April. The peat swamp developed under the influence of the deposition of marine sediments near the shoreline, and strong, continuous winds that formed a raised sandy beach parallel to the shoreline. This process finally separated a large, elongate depression from the sea.

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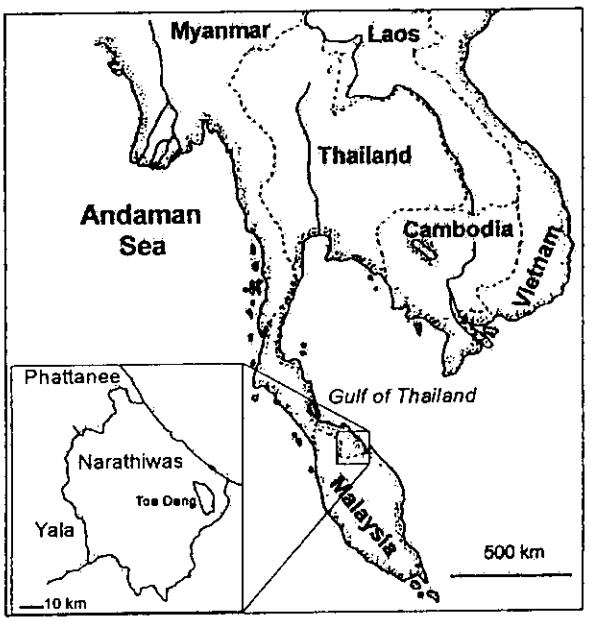


Fig. 1. Map of Thailand showing the location of To Daeng peat swamp in Narathiwas province.

Fig. 1. Carte de la Thaïlande indiquant la localisation du marais tourbeux To Daeng dans la province de Narathiwas.

When the connection to the sea was lost, a freshwater lake and swamp, fed by the heavy precipitation in the area, were formed. However, due to the high Sodium sulphate content of this coastal lake, decomposition rates are relatively low. This resulted in the formation of peat layers of varying thickness by the accumulation of dead organic material. In To Daeng peat swamp, this layer is generally over, or about 50 cm deep, and reaches a maximum thickness of up to 10 m in the central area of the swamp. The surface layer of peat (0-30 cm depth) is pronouncedly acidic (pH ca. 4), has a dark brown colour, and consists of decomposing organic material. Accordingly, the water in the swamp is acid, and has a characteristic brownish color (Phengklai et al. 1989).

2. Material and methods

Qualitative samples were collected in June and October 1998, and February 1999. The samples consist of several horizontal and oblique hauls, using a 26 µm mesh plankton net at several stations in the center and near the edges of the swamp. The samples were immediately preserved in 4% formaldehyde solution. Measurements of some physical and chemical parameters were made using a HORIBA, U-10 multimeter (see Table 1). Specimens were sorted, identified, drawn and prepared for scanning electron microscopy (SEM) following Chittapun et al. (1999).

3. Results and discussion

Species composition and zoogeography

A total of 67 rotifer species (66 Monogononta, 1 Bdelloidea) were identified (Table 2). The majority belonged to the genus *Lecane* (40.30 %), followed by *Lepadella* (10.45 %). This result corresponds well with existing information on the composition of the rotifer fauna of Thai peat swamps (Chittapun et al. 1999, Chittapun & Pholpunthin 2001).

One of the species recorded is new to science, and three are new to the Oriental region and Thailand. *Keratella taksinensis* n. sp. is described below. *Keratella mixta* (Oparina-Charitonova) (Fig. 2) is a rare rotifer, so far known only from temperate and cold regions in the Northern hemisphere (De Ridder & Segers 1997). Its occurrence in tropical Asia is surprising and it is, as yet, unclear what factor(s) account for its presence in Toa-Dang peat swamp. *Lecane enowi* Segers & Mertens (Fig. 3) has only recently been described from a temporary pond on an old palm plantation in Cameroon (Segers & Mertens 1997), and the present record is the second of this species. Considering that it is known only from two widely separated geographic localities, it appears premature to speculate on its biogeography. However, it may be part of a group of tropical Old-World taxa, which especially consists of *Lecane* species (Segers 1996, 2001). This group is here represented by nine taxa (Table 2), of which only three (*Lecane enowi*, *L. simonneae* and *Scaridium grande*) have not yet been recorded from tropical Australia. The third species, *Monommata dentata* Wulfert, is probably rare only because of the taxonomic difficulty of the genus, making that records of all but the largest and most easily recognized species are few. It is probably cosmopolitan, and has previously been recorded from the Ethiopian, Palaearctic, Nearctic and Australian regions (De Ridder 1986, De Ridder & Segers 1997). In addition to these, the record of the Thai endemic *Lecane superaculeata* Sanoamuang & Segers is noteworthy. This species had already been recorded from several localities in the North and Northeast (Sanoamuang 1997, 1998), and now also from Southern Thailand.

Table 1. Ranges of some physical and chemical measurements in To Daeng Peat swamp.
Tableau 1. Valeurs de quelques caractéristiques physico-chimiques mesurées dans le marais tourbeux de To Daeng.

Date	18/06/1998	31/10/1998	27/02/1999
Temperature (°C)	25.7-35.4	25.7-31.1	25.9-31.4
pH	4-6.0	4.0-6.1	4.2-5.9
Conductivity ($mS.cm^{-1}$)	0.04-0.14	0.01-0.42	0.01-0.11
Turbidity (NTU)	2.0-40.0	2.0-52.0	3.0-37.0

Table 2. Rotifers record from To Daeng peat swamp, Narathiwas province, southern Thailand.
Tableau 2. Rotifères dans le marais tourbeux de To Daeng, province de Narathiwas, Sud de la Thaïlande.

Anuraeopsis fissa (Gosse)
Brachionus quadridentatus Hermann, incl. f. *mirabilis* Daday
Cephalodella gibba (Ehrenberg)
C. innesi Myers
Colurella colurus (Ehrenberg)
C. obtusa (Gosse)
C. uncinata (Müller), incl. f. *bicuspidata* (Ehrenberg)
Dipleuchlanis propatula (Gosse) f. *macrodactyla* Hauer
Dissotrocha aculeata (Ehrenberg)
Euchlanis incisa Carlin
†*Keratella javana* Hauer
**K. mixta* (Oparina-Charitonova)
**K. taksinensis* n. sp.
Lecane aculeata (Jakubski)
L. arcula Harring
†*L. braumi* Koste
L. bulla (Gosse)
L. closterocerca (Schmarda)
L. curvicornis (Murray)
L. doryssa Harring
†**L. enowi* Segers & Mertens
L. furcata (Murray)
L. hamata (Stokes)
L. homemanni (Ehrenberg)
L. inermis (Bryce)
†*L. lateralis* Sharma
L. leontina (Turner)
L. ludwigii (Eckstein)
L. lunaris (Ehrenberg)
L. monostyla (Daday)
L. obtusa (Murray)
L. papuana (Murray)
L. pertica Harring & Myers
L. pyriformis (Daday)
L. signifera (Jennings)
†*L. simonneae* Segers
L. superaculeata Sanoamuang & Segers
L. tenuiseta Harring
†*L. unguitata* (Fadeev)
L. ungulata (Gosse)
Lepadella apsicora Myers
†*L. discoidea* Segers
L. ehrenbergi (Perty)
L. patella (Müller)
L. monodactyla (Bérzins)
L. rhomboides (Gosse)
†*L. vandenbrandei* Gillard
Macrochaetus collinsi (Gosse)
Manfredium eudactylotum (Gosse)
**Monommata dentata* Wulfert
M. grandis Tessin
M. longiseta (Müller)
Notommata saccigera Ehrenberg
Plationus patulus (Müller)
Platyias quadricornis (Ehrenberg) f. *brevispinus* Daday
Polyarthra minor Voigt
†*Scaridium grande* Segers
S. longicaudum (Müller)
Squatinella leydigii (Zacharias) f. *longiseta* Pourriot
Testudinella parva (Ternetz)
T. patina (Hermann)
T. tridentata Smirnov
Trichocerca brasiliensis (Murray)
T. jenningsi Voigt
T. siamensis Segers & Pholpunthin
T. similis (Weirzejski) f. *grandis* Hauer
Trichotria tetractis (Ehrenberg)

* New to the Oriental region and to Thailand

† Palaeotropical species

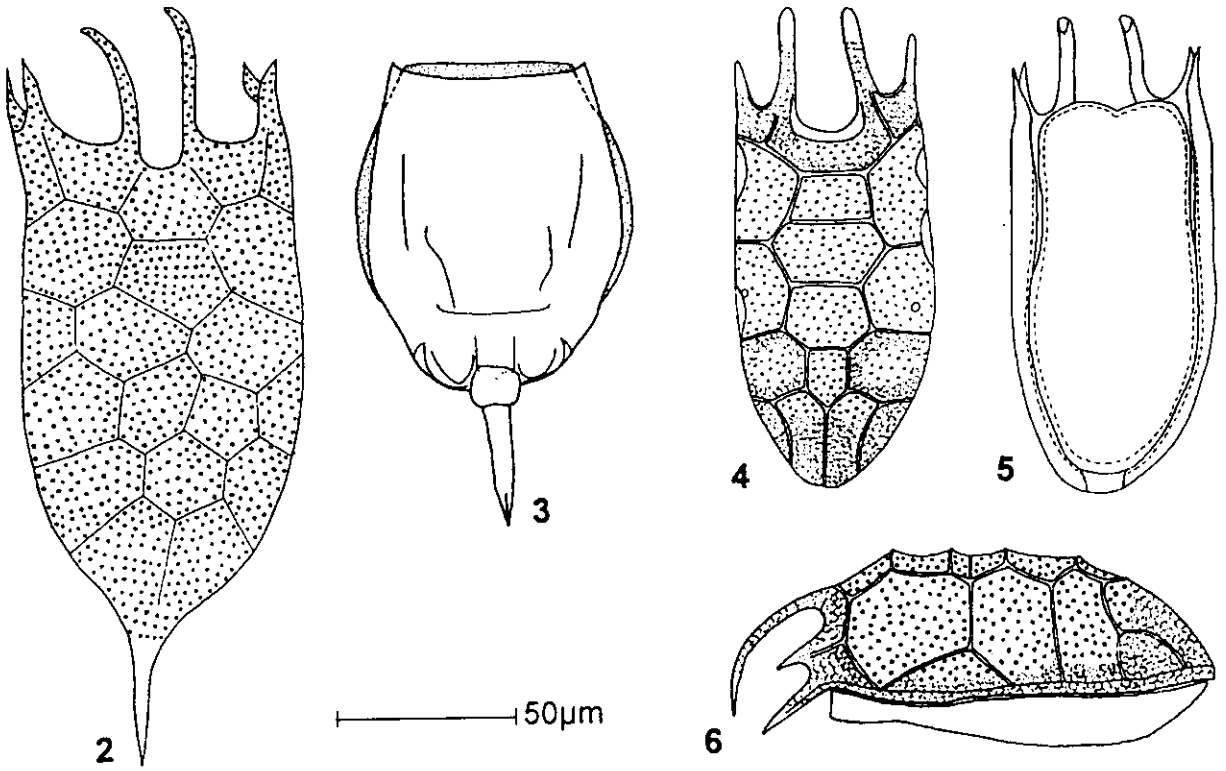


Fig. 2. *Keratella mixta* (Oparina-Charitonova) - dorsal view ; Fig. 3. *Lecane enowi* Segers & Mertens - ventral view ; Figs 4-6. *Keratella taksinensis* n. sp. - 4: dorsal view, 5: ventral view, 6: lateral view.

Fig. 2. *Keratella mixta* (Oparina-Charitonova) - vue dorsale; Fig. 3. *Lecane enowi* Segers & Mertens - vue ventrale, Figs 4-6. *Keratella taksinensis* n. sp. - 4: vue dorsale, 5: vue ventrale, 6: vue latérale.

Description of *Keratella taksinensis* n. sp.

(Figs 4-6, 7-11)

Type locality : Littoral area of Toa-Dang peat-swamp, Narathiwas province, Thailand, coll. October 1998.

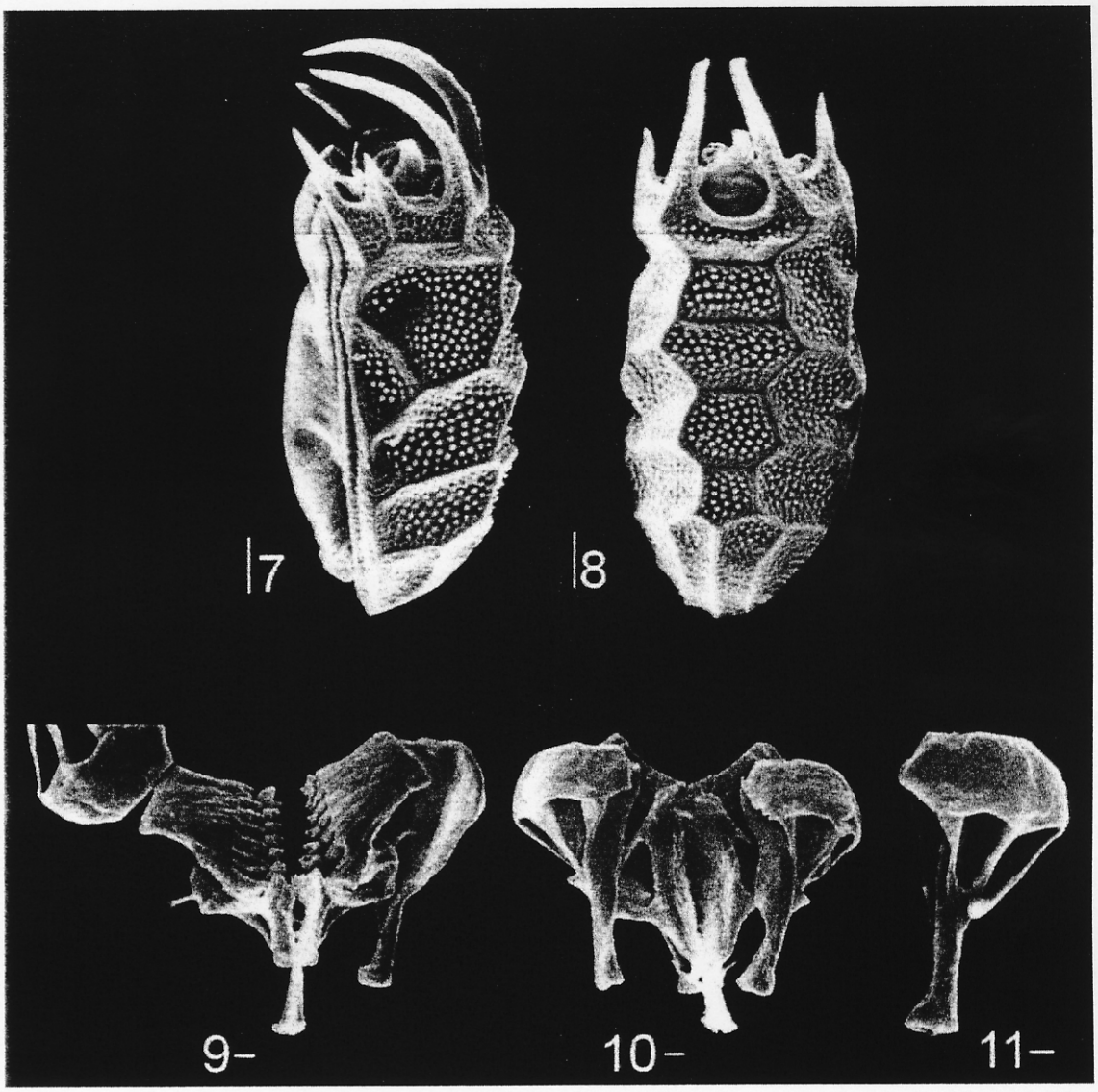
Material examined : Holotype and paratype in the royal Belgian Institute for Natural Sciences, Brussels, Belgium (IG: 29717, RIR 136) ; one paratype in the collection of the Institute of Animal Ecology, Ghent University, Ghent, Belgium. Numerous additional specimens present in the original sample (in PSU) from the type locality.

Differential diagnosis

Keratella taksinensis n. sp. is diagnosed by the presence of four enclosed median facets on the dorsal lorica, posteriorly terminating in a mid-dorsal ridge. As such, it can hardly be confused with any other *Keratella*. The new species bears some resemblance with *K. procurva* (Thorpe) and *K. serrulata* (Ehrenberg), but these species have only three or two enclosed median facets, respectively. Four enclosed median facets occur also in *K. paludosa* (Lucks), *K. ticinensis* (Callerio) and *K. trapezoida* Zhuge & Huang. However, the presence of elongate postero-carinal facets distinguishes *K. taksinensis* n. sp. from these.

Description

Parthenogenetic female (male unknown) : Lorica stiff, relatively thick, nearly twice as long as wide. Lateral margins nearly parallel, posteriorly rounded. Ventral plate relatively soft, anterially bilobate with median concavity. Dorsal plate stiff; ridges delimiting the facets well-developed. Lorica surface ornamented with large pustules on median and lateral facets, with re-



Figs 7-11. *Keratella taksinensis* n. sp. SEM photographs. - 7: lorica, lateral view, 8: lorica, dorsal view, 9-11: trophi: 9: frontal, 10: caudal view, 11: manubrium, lateral view. Scale bars: 7-8: 10µm, 9-11: 1µm.

Figs 7-11. *Keratella taksinensis* sp. n., MEB photographies. - 7: lorica, vue latérale, 8: lorica, vue dorsale, 9-11: trophi: 9: vue frontale, 10: vue caudale, 11: manubrium, vue latérale. Echelle :7 -8: 10µm, 9-11: 1µm.

ticulate patterns on lateral frontal posterior facets. Six thick, well-developed anterior spines, median pair long and curved ventral, lateral pair longer than intermediate pair, relatively sharp and twice as long as the intermediate pair. Apertures to the lateral antennas approximately half way along the lorica.

Foundation pattern consisting of a row of five median facets. Median frontal area broad, anterior median facet trapezoidal, second hexagonal, wider than long and widest anteriorly, third hexagonal and forth pentagonal, extending posteriorly in a median ridge. A pair of elongate posterocarinal facets present. Three pairs of lateral facets, and a pair of elongate postero-margi-

nal facets present. A small triangular facet present between the first and second lateral facets. Second lateral facet with aperture to the lateral antenna, this aperture bordered by six fused pustules. No posterior spines.

Trophi malleate, nearly symmetrical. Fulcrum short, with basal plate. Ram triangular, with well developed inner projections consisting of fused, minute teeth. Allulae absent. Both unci with eight teeth, anterior teeth the strongest, with remnants of additional anterior teeth. Two dorsal pairs of teeth weaker than main teeth. Shafts of teeth connected. Manubria with posterior lamellae prolonged along the shaft.

Measurements (in µm) : Dorsal plate length 87 - 109, width 48 - 61, Ventral plate length 92 - 100, width 41 - 45, Lorica depth 39, Head aperture : antero-median spine length 31 - 48, intermediate spine 11 - 18, lateral spine 17 - 20. Trophi : fulcrum length 3, rami width 5, uncus length 1.4, manubrium length 13.

Distribution and ecology

This species is known only from a water body under the hiking trail bridge near To Daeng sanctuary office. Water temperature 25.7 - 25.9 °C, pH 4.9 - 5.8, DO 0.89 - 1.74 $mg.l^{-1}$, conductivity 0.015 - 0.028 $mS.cm^{-1}$, turbidity 2 - 3.6 NTU.

Etymology

The name of the new species is a toponym, and is derived from the word 'Taksin', Thai for the Southern part of Thailand.

Acknowledgments

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References

Chittapun S., Pholpunthin P. & Segers H. 1999. — Rotifera from peat-swamps in Phuket Province, Thailand, with the description of a new *Colurella* BORY DE ST. VINCENT. *Internat. Rev. Hydrobiol.*, 84 : 587-593.

Chittapun S., & Pholpunthin. P. 2001. — The rotifer fauna of peat-swamps in Southern Thailand. *Hydrobiologia*, 446/447 : 255-259.

De Ridder M., 1986. — *Annotated Checklist of non-marine Rotifers (Rotifera) from African Inland Waters.* Zoologische Dokumentatie 2. K.M.M.A. Tervuren, Belgium : 123 p.

De Ridder M., & Segers H., 1997. — Rotifer Monogononta in six zoogeographical regions after publications between 1960-1992. *In : Studiedocumenten van het Koninkrijk Belgisch Instituut voor Natuurwetenschappen* J. Van Goethem (ed). Brussels, Belgium : 481 p.

Phengklai C., Niyomdham C., Premrasmi A., Chirathanakorn K. & Phuma R., 1989. — Peat swamp forest of Thailand. *Thai Forest Bull.*, 18 : 1-42.

Sanoamuang L., 1998. — Rotifera of some freshwater habitats in the floodplain of the River Nan, northern Thailand. *Hydrobiologia*, 387/388 : 27-33.

Sanoamuang L. & Segers H. 1997. — Additions to the *Lecane* fauna (Rotifera: Monogononta) of Thailand. Internat. *Rev. Hydrobiol.*, 82 : 525-530.

Segers H., 1996. — The biogeography of littoral *Lecane* Rotifera. *Hydrobiologia*, 323 : 169-197.

Segers H. 2001. — Zoogeography of the Southeast Asian Rotifera. *Hydrobiologia*, 446/447 : 233-246.

Segers H. & Chittapun S. 2001. — The Interstitial Rotifera of a Tropical Freshwater Peat Swamp on Phuket Island, Thailand. *Belg. J. Zool.*, 131 (Suppl. 2) : 65-71

Segers H. & Mertens J. 1997. — New Rotifera from the Korup National Park, Cameroon. *J. Nat. Hist.*, 31 : 663-668.

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Contribution to the knowledge of Thai microfauna diversity: notes on rare peat swamp Rotifera, with the description of a new *Lecane* Nitzsch, 1872

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Abstract

During an ongoing study of the rotifer diversity in Thai peat swamps, several new or rare species were found. We here report on one new species, *Lecane kunthuleensis* n.sp., from a canal in Kun Thu Lee peat swamp, and on three rare species: *Paracolurella aemula* (Myers, 1934) and *Lecane junki* Koste, 1975 from Kra Jood peat swamp (Suratthanee province), and *Lepadella punctata* Wulfert, 1939 from To-Daeng peat swamp (Narathiwas province).

Introduction

The rotifer fauna of peat swamps in Southern Thailand has been studied extensively in recent years (Chittapun et al., 1999; Chittapun & Pholpunthin, 2001; Segers & Chittapun, 2001; Chittapun et al., 2002). To date, a total of 148 different rotifer species was recorded from this habitat. This number includes many species that had not been recorded from the Oriental region or Thailand before, and five that were new to science. This contributed significantly to the Thai rotifer record, which now stands at some 340 species (Sanoamuang, 2001; Segers, 2001; Segers & Chittapun, 2001; Chittapun et al., 2002). Clearly, the peat swamp ecosystems of Southern Thailand have a highly diverse and distinct rotifer fauna, a result of their long history, and characteristic ecological conditions (see Phengklai et al., 1989). Although contributions dealing with the rotifer fauna of Kun Thu Lee and Kra Jood peat swamps in Suratthanee province, and To-Daeng peat swamp in Narathiwas province are available (Fig. 1; Chittapun & Pholpunthin, 2001; Chittapun et al., 2002), we here report on an additional number of remarkable species.

Materials and methods

The peat swamp rotifers were sampled during several occasions (see Chittapun & Pholpunthin, 2001; Chittapun et al., 2002) using a 26 μm mesh plankton net. Samples were immediately preserved in 4% formaldehyde solution. Measurements of some physical and chemical parameters were done using a HORIBA, U-10 multimeter. Specimens were sorted, identified, drawn and prepared for scanning electron microscopy (SEM) following Chittapun et al. (1999). Light microscopy photographs were taken under an Olympus CX40RF2000 dissecting microscope fitted with an Olympus DP11 camera connected to a personal computer.

Results and discussion

Notes on selected taxa

Lecane kunthuleensis **new species (Figs 2, 3 and 8)**

Type locality: Between submerged macrophytes in a canal in Kun Thu Lee peat swamp, Suratthanee province, Thailand (Fig. 1: 99° 07.39′ E-99° 07.45′

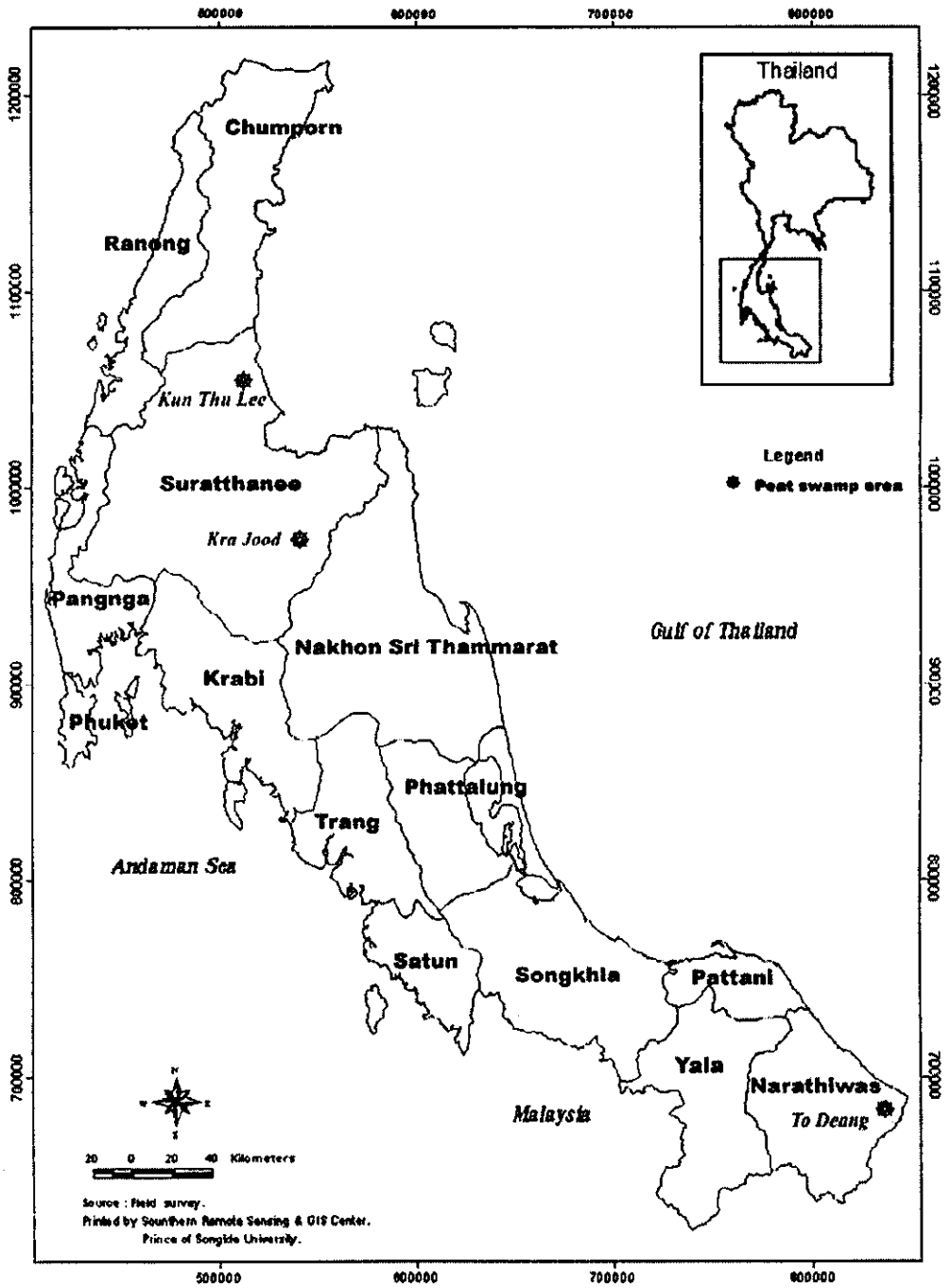
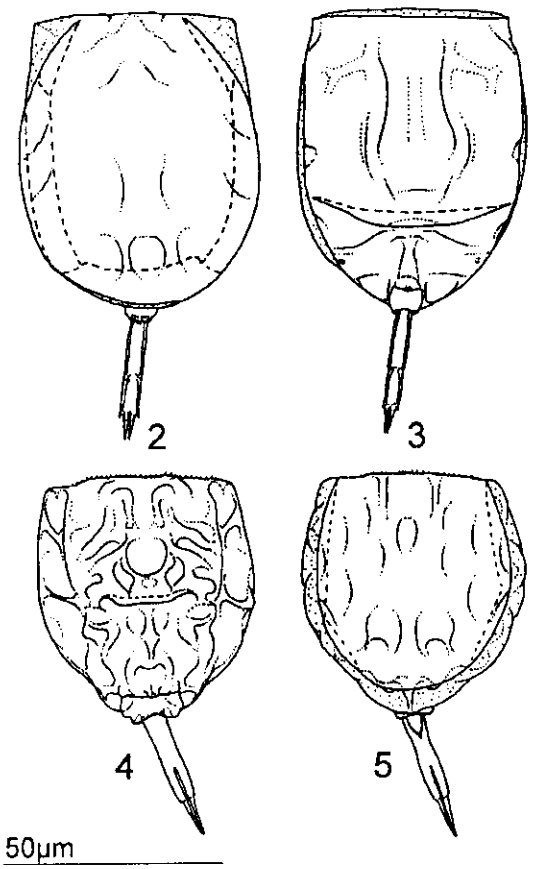


Figure 1. Map of Southern Thailand showing the location of the three peat swamps areas: Kun Thu Lee, Kra Jood and To-Daeng.



Figures 2–5. Lecane spp., habitus. 2: *L. kunthuleensis* n.sp. ventral, 3: *L. kunthuleensis* n.sp. dorsal; 4: *L. junki* Koste ventral, 5: *L. junki* Koste dorsal.

E, 9° 41.03′ N-9° 41.08′ N), coll. 23 October 1998.

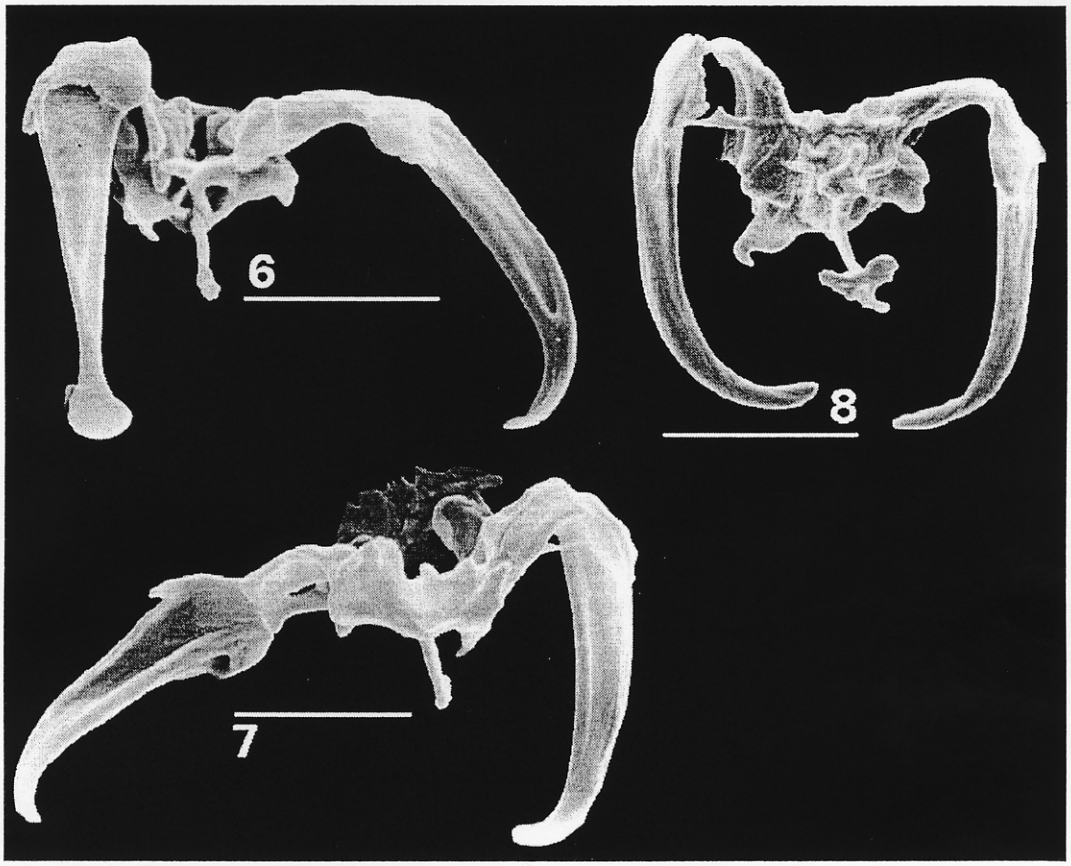
Material examined:
Holotype and paratype in Natural History Museum, Prince of Songkhla University (PSU), Hat Yai, Songkla province, Thailand; one paratype and one trophi slide in Plankton Research Unit, PSU (PRU2), and in the Science Museum, Khon Kaen University (KKU), Khon Kaen; two paratypes in the royal Belgian Institute for Natural Sciences, Brussels, Belgium (IG 29747 RIR 137-138). More specimens were present in the original sample (in PSU) from the type locality.

Differential diagnosis:
Lecane kunthuleensis n. sp. belongs to the *L. lunaris* group, and keys out to this species following the key by Segers (1995). It especially resembles *L. nigeriensis* Segers and *L. namatai* Segers & Mertens, as it shares with these its general lorica shape and complete, posteriorly smoothly curved transverse fold on the ventral lorica plate. In contrast to these two, *L. kunthuleensis* n. sp. has straight and concurrent head aperture margins (with distinct median concavity in *L. nigeriensis* and *L. namatai*). In addition, it has an ornamented, and relatively wide lorica (smooth in *L. nigeriensis* and *L. namatai*). Compared to the remaining taxa in the *L. lunaris* group, *L. kunthuleensis* n. sp. can only be confused with *L. scutata*, which has superficial lateral sulci and a different toe shape.

Description:
Female: Loricate *Lecane*. Dorsal plate anteriorly narrower, medially wider than ventral plate. Head aperture margins straight, nearly coincident with the dorsal projecting, and with a pair of notches dividing the dorsal head aperture margin in a narrow median and two wider lateral parts. Head aperture only slightly narrower than ventral lorica. Antero-lateral corners angulate. Ventral plate length ca. 1.3–1.4 times width, with complete, posteriorly smoothly curved transverse fold, ornamented. Lateral margin notched. Foot plate broad, coxal plate triangular. Prepedal fold broadly rounded distally. Foot pseudosegment simple, widest in distal third, lateral margins smooth, not or only slightly projecting, bearing a single toe and a relatively large dorsal pedal lobe. Toe parallel-sided, with a pair of pseudoclaws and accessory claws and a transverse constriction at 2/5th from the toe tip.
Trophi (Fig. 8): Manubria and unci symmetrical. Fulcrum with well developed basal plate. Rami asymmetrical: right ramus with oblique downward and strongly bend hook-shaped alulus. Unci strongly asymmetrical, right frontal teeth particularly developed.

Measurements:
Dorsal plate length 59.2–67.3 µm, width 49.4–52.9 µm, Ventral plate length 64.4–68.3 µm, width 45.8–49.5 µm, Toe 20.6–24.5 µm, Pseudoclaw 5.1–7.0 µm. Trophi length 20.8 µm, fulcrum 6.2 µm, incus width 11.0 µm, uncus length 7.2 µm.

Distribution and ecology:
This species is known only from a pond and a canal in Kun Thu Lee peat swamp, Suratthanee province. Water temperature was 25–25.4 °C, pH 5.35–5.75, DO 3.26–4.58 $mg.l^{-1}$, Cond. 0.015–0.019 $mS.cm^{-1}$ and turbidity 23–37 NTU.



Figures 6–8. *Lecane* spp., trophi SEM. 6: *L. junki* Koste ventral, 7: *L. junki* Koste dorsal; 8: *L. kunthuleensis* n.sp. dorsal ventral (scale bars: 10 μm).

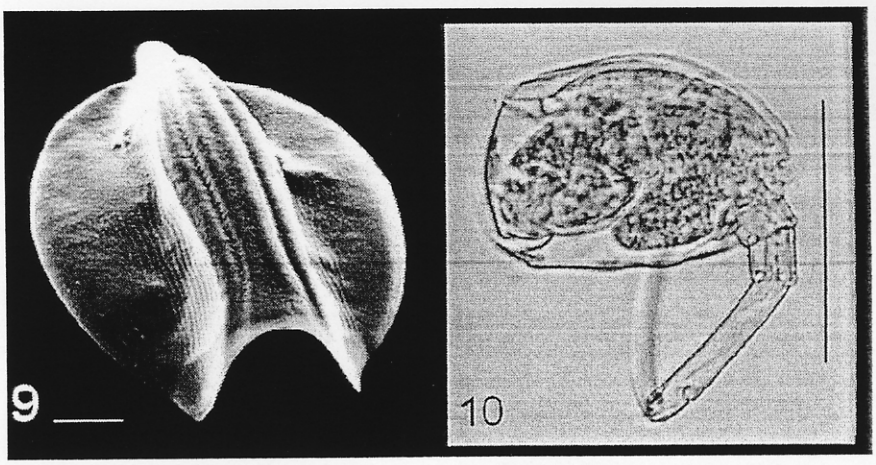
Etymology:
The name of the new species refers to type locality of the animal, Kun Thu Lee peat swamp.

Lecane junki **Koste, 1975 (Figs 4–5, 6–7)**
Material examined: Numerous specimens from the littoral zone of Kra Jood peat swamp, Suratthanee province, Thailand (Fig. 1: 99° 16.27′ E–99° 16.31′ E, 8° 53.65′ N–8° 53.71′ N), collected 23 October 1998. Permanent slides are deposited in the Plankton Research Unit, Department of Biology, Faculty of Science, Prince of Songkla University, Hat Yai, Songkhla, Thailand, the Department of Biology, Khon Kaen University (KKU), Khon Kaen, Thailand.

Comments:
L. junki was described from the littoral of Bung-Borapet Lake, North Thailand (Koste, 1975), and has only now been found again. The present record is from a different type of habitat, and confirms the status of this species as a Thai endemic. The species is unmistakable by the small spicules on the ventral head aperture margin and by the presence of characteristic coxal plates, foot with relatively large pedal lobe, and toe.
Trophi (Figs 6–7): Manubria symmetrical. Fulcrum straight, rod-shaped. Rami asymetrical, right ramus with downwardly curved alulus. Unci weakly asymmetrical.

Measurements:
Dorsal plate length 52 μm, width 55 μm, ventral plate length 54 μm, width 58 μm, Toe 30 μm, claw 19 μm. Trophi length 19.6 – 20.4 μm, fulcrum 4.1 – 4.2 μm, incus width 9.4 – 10 μm, uncus length 8.3 – 8.9 μm.

Ecology:
Water temperature 25.8 – 27.2 °C, pH 5.59 – 5.98, DO 7.1 – 7.8 $mg.l^{-1}$, conductivity 0.023 – 0.032 $mS.cm^{-1}$, turbidity 11 – 43 NTU.



Figures 9–10. Lepadella punctata Wulfert, oblique frontal and dorsal, SEM photograph (scale bar: 10 μm). *Paracolurella aemula* Myers, lateral. Light microscopy photograph (scale bar: 50 μm).

Lepadella punctata **Wulfert, 1939 (Fig. 9)**
Material examined:
A few specimens from To Daeng peat swamp, Narathiwas province, Thailand, (Fig. 1: 101° 55′ E–102° 03′ E, 06° 03′ N–06° 03′ E), collected on 18 July 1998.

Ecology: Water temperature 27–35 °C, pH 4.0–6.04, conductivity 0.035–0.138 $mS.cm^{-1}$, turbidity 7–24 NTU.

Note:
L. punctata was to date only known from two specimens from type locality in Germany, Europe (Wulfert, 1939). The species is related to *L. triptera* (Ehrenberg), but is unmistakable by the presence of four more or less parallel ridges on the dorsal plate. This apparently rare species is new to the Oriental region.

Paracolurella aemula **(Myers, 1934) (Fig. 10)**
Material examined:
A few specimens from the littoral of Kra Jood peat swamp, Suratthanee province, Thailand, (Fig. 1: 99° 16.27′ E–99° 16.31′ E, 8° 53.65′ N–8° 53.71′ N), collected on 23 October 1998. Permanent slides are in the Plankton Research Unit, Department of Biology, Faculty of Science, Prince of Songkla University, Hat Yai, Songkhla, Thailand.

Ecology:
Same as for *L. junki.*

Note:
Paracolurella aemula can be distinguished from its congener *P. logima* by its third foot pseudosegment being only slightly longer than the toes, and species-specific lorica shape. Although this is the first record of *P. aemula* from Thailand, it had been reported from the Oriental region before (Singapore, India, Indonesia: Sudzuki, 1989; De Ridder & Segers, 1997). This rare Pantropical species is also known from South America (Brazil: De Ridder & Segers, 1997), and Africa (Congo, Nigeria, Lake Tanganyika: De Ridder, 1986, 1991, 1994).

Measurements:
Lorica length 62 μm, width 43 μm, Last foot pseudosegment length 38 μm, Toe length 30 μm.

Concluding remarks

In addition to the species treated above, two more remarkable taxa were found. *Lepadella minoruoides* Koste & Robertson, 1983 and *Testudinella walkeri* Koste & Shiel, 1980, both found by us in Kra Jood peat swamp, have been recorded from Thailand before (Segers & Pholpunthin, 1997; Sanoamuang & Savatenalinton, 2001), but these species remain rare globally. The former is widely distributed in tropical regions (Segers et al., 1993), whereas the latter is apparently Australasian (Segers & Pholpunthin, 1997; Segers, 2001). However, records of both are few. That these rare species are known from several localities in Thailand illustrates that the coverage of freshwater biodiversity studies in the country is relatively good, compared to other tropical regions.

Notwithstanding that Thailand has recently become the most well studied Southeast Asian country (Segers, 2001), it is clear that the record on the biodiversity of the most species-rich group of primarily freshwater Metazoa, the Rotifera, remains incomplete. This is exemplified by the present additions, and those in other recent publications (e.g., Segers & Chittapun, 2001; Chittapun et al., 2002). The present results moreover expand the gap in knowledge on freshwater biodiversity between Thailand and other Southeast Asian countries, which argues for more extensive research in these countries.

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References

Chittapun, S & P. Pholpunthin, 2001. The rotifer fauna of peat-swamps in Southern Thailand. Hydrobiologia 446/447: 255–259.

Chittapun, S., P. Pholpunthin & H. Segers, 1999. Rotifer from peat-swamps in Phuket Province, Thailand, with the description of a new *Colurella* Bory de St. Vincent. Int. Rev. Hydrobiol. 84: 587–593.

Chittapun, S., P. Pholpunthin & H. Segers, 2002. Rotifera diversity in a peat-swamp in southern Thailand (Narathiwas province), with the description of a new *Keratella* Bory de St. Vincent. Annls. Limnol., 38: 185–190.

De Ridder, M., 1986. Annotated checklist of non-marine Rotifera from African inland waters. Zool. Doc., KMMA, Tervuren, 21: 123 pp.

De Ridder, M., 1991. Additions to the 'Annotated checklist of non-marine rotifers from African inland waters'. Rev. Hydrobiol. trop. 24: 25–46.

De Ridder, M., 1994. Additions II to the 'Annotated checklist of non-marine rotifers from African inland waters'. Biol. Jb. Dodonaea 61: 99–153.

De Ridder, M. & H. Segers, 1997. Rotifera Monogononta in six zoogeographical regions after publications between 1960 and 1992. In Van Goethem, J. (ed.), Studiedocumenten van het Koninkrijk Belgisch Instituut voor Natuurwetenschappen. Brussels, Belgium. 481 pp.

Koste, W., 1975. Über den Rotatorienbestand einer Mikrobiozönose in einem tropischen aquatischen Saumbiotop, der *Eichernia-crassipes* Zone im Litoral des Bung-Borapet, einem stausee in Zentralthailand. Gewässer und Abwässer 57/58: 43–58.

Phengklai, C., C. Niyomdham, A. Premrasmi, K. Chirathanakorn & R. Phuma. 1989. Peat Swamp Forest of Thailand. Thai For. Bull. 18: 1–42.

Sanoamuang, L., 2001. Diversity of Freshwater Zooplankton in Thailand. BRT Research Reports: 1–16.

Sanoamuang, L.& S. Savatenalinton, 2001. The rotifer fauna of Lake Kud-Thing, a shallow lake in Nong Khai Province, northeast Thailand. Hydrobiologia 446/447: 297–304.

Segers, H., 1995. Rotifera. Vol 2: The Lecanidae (Monogononta). Guides to the identification of the Microinvertebrates of the Continental Waters of the World 6. SPB Academic Publishing bv. The Hague, The Netherlands. 226 pp.

Segers, H., 2001. Zoogeography of the Southeast Asian Rotifera. Hydrobiologia 446/447: 233–246.

Segers, H. & S. Chittapun, 2001. The interstitial Rotifera of a tropical freshwater peat swamp on Phuket Island, Thailand. Belg. J. Zool. 131 (suppl. 2): 65–71.

Segers, H. & P. Pholpunthin, 1997. New and rare Rotifera from Thale-Noi Lake, Pattalang Province, Thailand, with a note on the taxonomy of *Cephalodella* (Notommatidae). Annls Limnol. 33: 13–21.

Segers, H., C. S. Nwadiaro & H. J. Dumont, 1993. Rotifera of some lakes in the floodplain of the river Niger (Imo State: Nigeria). II. Faunal composition and diversity. Hydrobiologia 250: 63–71.

Sudzuki, M., 1989. Rotifera from the Oriental region and their characteristics. Special Issue celebrating the centennial anniversary of the foundation of Nihon Daigaku University, Tokyo 3: 325–366.

Wulfert, K., 1939. Einige neue Rotatorien aus Brandenburg und Pommern. Zool. Anz. 127: 65–75.