

## NOTES ON SOUTHEAST ASIAN *RANATRA* (HETEROPTERA: NEPIDAE), WITH DESCRIPTION OF A NEW SPECIES FROM SINGAPORE AND NEIGHBOURING INDONESIAN ISLANDS

**A. D. Tran**

Department of Invertebrate Zoology, Faculty of Biology, Hanoi University of Science  
334 Nguyen Trai, Thanh Xuan, Hanoi, Vietnam  
Email: tran.anhduc@hus.edu.vn

**Dan A. Polhemus**

Department of Natural Sciences, Bishop Museum, 1525 Bernice St., Honolulu, HI 96817 USA  
Email: bugman@bishopmuseum.org

**ABSTRACT.** — A new species of water scorpion, *Ranatra rafflesi*, is described from Singapore and neighbouring Indonesian islands (Bintan and Batam). This new species is similar morphologically to *R. malayana* from Sulawesi and *R. natunaensis* from Natuna Island, its closest putative relatives. In addition, based on an analysis of male paramere character states, we elevate *Ranatra longipes thai* Lansbury to full species status as *R. thai* Lansbury, new status. Illustrations are provided for key characters separating *R. rafflesi* from other similar species occurring in Southeast Asia, including the structures of the male forelegs, parameres, and phallosome, as well as the fine details of male paramere structure for *R. longipes longipes* and *R. thai*.

**KEY WORDS.** — Nepidae, *Ranatra*, Singapore, Indonesia, Southeast Asia, new species, new status

### INTRODUCTION

The water scorpions of the genus *Ranatra* are elongate, yellowish-brown insects that usually are found along the margins of lentic ecosystems amid tangles of submerged sticks and weeds, which they closely resemble. The genus is primarily pantropical in distribution, although not particularly rich in species. The species of *Ranatra* occurring in the Indo-Australian region were competently revised by Lansbury (1972), with subsequent descriptions of new species and distribution records from the region by Nieser & Chen (1991, 1999), Nieser (1996, 1997), Zettel (1999), and Chen et al. (2004, 2005), and further records from China provided by Nieser et al. (2005). Despite this, species concepts among the Southeast Asian members of this genus remain inadequately delimited. In this paper, we describe a new species in the *R. biroi* group, and clarify certain species and subspecies concepts in the *R. longipes* complex.

### MATERIAL AND METHODS

The specimens listed in the Material Examined section are either preserved in ethanol or dry pinned in the Zoological Reference Collection (ZRC) of the Raffles Museum of

Biodiversity Research, National University of Singapore, or in the J. T. Polhemus Collection, Englewood, Colorado, USA (JTTC); a pair of dry pinned paratypes of *R. rafflesi* are also deposited in Bishop Museum, Honolulu, Hawaii, USA (BPBM). Additional material in the collections of the National Museum of Natural History, Smithsonian Institution, Washington, DC (USNM) was also examined. All measurements in the description below are given in millimeters.

### TAXONOMY

#### *Ranatra longipes longipes* Stål, 1861 (Figs. 1–4, 9, 11)

*Ranatra longipes* Stål, 1861: 203.

*Ranatra longipes longipes* Lansbury, 1972: 332.

**Material examined.** — INDONESIA: **Jawa Barat Prov.**: 20 males, 13 females, Java, Buitenzorg [Bogor], Apr.–Dec.1896, coll. D. G. Fairchild (USNM); 1 male, 1 female, same locality as above but 1919, coll. W. C. Heurn (USNM); 1 male, Java, Ciapus Dist., rocky river, waterfall and tribs. at Curug Luhur recreation area, 750 m, water temp. 22°C, coll. D. A. & J. T. Polhemus, 5 Sep.1991, CL 2579 (USNM). **Jambi Prov.**: 1 male, Sumatra, Sungai Alai at 28

km on road from Muara Bungo–Muara Tebo, coll. M. Kottelat & H. H. Tan, 30–31 May 1994 (ZRC.6.22207). **Bengkulu Prov.:** 1 female, Sumatra, Pauh River, 25 km SE of Muaraaman, 600 m, 3°16'05"S, 102°22'47"E, water temp. 23°C, coll. D. A. & J. T. Polhemus, 8 Sep.1991, CL 2584, (JTPC). **Sumatera Barat Prov.:** 1 male, West Sumatra, coll. Fruhstorfer (USNM). **Kalimantan Timur Prov.:** 21 males, 12 females, Borneo, Mahakam River basin, small spring in sandstone 3 km NE of Kota Bangun, coll. J. T. & D. A. Polhemus, 28 Aug.1985, CL 2092 (JTPC); 4 males, rice paddies 11 km NE of Samarinda, coll. D. A. & J. T. Polhemus, 27 Aug.1985, CL 2090 (JTPC); 2 males, 1 female, Borneo, stream 4 km NE of Kota Bangun on Samarinda road, coll. D. A. & J. T. Polhemus, 29 Aug.1985, CL 2097 (JTPC). **SINGAPORE:** 1 male, fish pond near Kranji Reservoir, coll. K. L. Yeo (ZRC.6.15744); 1 male, Seletar Reservoir Park, coll. K. L. Yeo, 7 Nov.1990 (ZRC); 1 male, 1 female, Nee Soon swamp forest, pump house, 1<sup>st</sup> stream, coll. K. Lim & K. L. Yeo, 31 Oct.1990 (ZRC.6.15745–15746); 2 males, 1 immature, Nee Soon swamp forest, nr. pump house, coll. K. L. Yeo, 20 Sep.1993, Y843 (ZRC); 1 male, 2 immatures, Nee Soon swamp forest, beside pump house, coll. K. L. Yeo, 26 Aug.1993, Y840 (ZRC.6.22223); 1 male, 4 females, Sg. Buloh, coll. L. Hendrich, 5 Dec.1996 (ZRC.6.22206); 1 male, Lorong Banir, coll. K. L. Yeo & M. Balke, 21 Apr.1998, NS0235 (ZRC); 2 males, 1 female, 3 immatures, Lorong Banir, coll. M. Balke et al., 28 Apr.1997, NS236 (ZRC.6.22236); 2 males, 16 immatures, beside Nee Soon pond habitat, coll. K. L. Yeo, 19 Sep.1991, Y771 (ZRC.6.15666–15684); 1 female, Sime Road, coll. H. H. Ng et al., 30 Oct.2008 (ZRC); 1 male, 2 females, Nee Soon Pumphouse, coll. K. L. Yeo, 6 Dec.1996, Y892 (ZRC); 1 male, Nee Soon swamp forest, coll. H. K. Lua, 29 Sep.1990 (ZRC); 2 males, 1 female, Bukit Timah Nature Reserve, coll. H. K. Lua et al., 13 Dec.1995, NS214 (ZRC); 1 male, 1 female, Seletar Reservoir, Mandai Lake Road, 16 May 1994, NS134A (ZRC); 2 males, 3 females, MacRitchie Reservoir inlet "Cc" to stream, coll. Y. H. Lim, 7 Jun.1994, NS153 (ZRC); 2 females, Lorong Banir Stagnant pond, coll. T. B. Lim et al., 10 Jun.1994, NS157F (ZRC); 1 female, Lorong Banir, pond 3, coll. H. K. Lua et al., 14 Jul.1995, NS199 (ZRC.6.18386); 1 female, Chestnut Ave., stream flowing into Seletar Reservoir, coll. H. K. Lua et al., 26 May 1994, NS142D (ZRC); 1 male, 1 female, 1 immature, Pulau Tekong Reservoir, edge, coll. C. M. Yang & R. Tan, 20 Dec.2001, YCM0282A (ZRC.6.22221); 2 males, 1 female, 2 immatures, Bukit Batok Town Park, coll. H. K. Lua et al., 23 Apr.1997, NS232 (ZRC). **MALAYSIA:** **Sabah:** 1 male, Borneo, small slow stream in oil palm plantations, 52 km NW of Kota Belud, coll. D. A. & J. T. Polhemus 4 Aug.1985, CL 2030 (JTPC); 2 males, 1 female, Borneo, swamp 5 km N. of Tamparuli, coll. D. A. & J. T. Polhemus, 5 Aug.1985, CL 2034 (JTPC). **Johor:** 1 male, Malay Peninsula, clearwater flowing stream, coll. H. H. Tan et al., 11 Mar.1998, THH9818 (ZRC); 1 male, 1 female, Ayer Hitam, coll. C. M. Yang, K. Lim & K. L. Yeo, 23 May 1991 (ZRC); 1 male, Sungei Kayu, coll. H. H. Tan & O. S. K. Chia, 12 Mar.1998, THH9823 (ZRC.6.22235); 1 male, Johor, Kota Tinggi, Gg. Panti foothill, track 266, swampy stream, coll. M. Kottelat & P. K. L. Ng, 22 Jan.1991 (ZRC.6.15743); 6 males, 5 females, Ayer Hitam, stream with vegetation from Parit Botak Batu Pahat, 131 km from Mersing, coll. C. M. Yang, K. Lim & K. L. Yeo, 23 May 1991 (ZRC.6.15760–15770); 2 males, 1 female, Layang Layang stream I, muddy water with vegetation on side, coll. ZRC staff, 6 Feb.1991 (ZRC.6.15751–15753); 1 male, 2 females, Malay Peninsula, swamp forest stream 61 km N. of Johor Bharu on Mersing Road, coll. D. A. & J. T. Polhemus, 16 Oct.1986, CL 2220 (JTPC).

**Discussion.** — The status of the various subspecies of *Ranatra longipes* remains confusing and uncertain. The nominate form was described from Java (Stål, 1861), with subsequent records from Sumatra (Lundblad, 1933), Borneo

(Lansbury, 1972), and Peninsular Malaysia (Fernando & Cheng, 1974); as noted below, the latter Malaysian records are largely if not entirely referable to *R. thai* Lansbury, new status (see next section). Lansbury (1972) also described the subspecies *R. longipes celebensis* from the southwestern peninsula of Celebes. Nieser & Chen (1991), when providing further records of *R. longipes* from the southeastern peninsula of Celebes, specifically noted that their specimens did not conform to the diagnosis of *R. longipes celebensis*, and instead represented the nominate subspecies; these authors also made passing reference to additional specimens of *R. longipes* they had seen from Bali.

The series listed above from Java, collected by Fairchild, includes a male specimen bearing a label reading "*Ranatra longipes* Stål det Montandon 1909". The male from Java collected by Heurn has the male genital capsule dissected and mounted on a card beneath the specimen, allowing ready examination of the male paramere, which displays the same distinctive small subapical tooth on the inner curve of the distal hook as shown in Figs. 2 and 4 for specimens from Singapore and Borneo.

Overall, *R. longipes* may be recognised by its slender, delicate form, and its relatively small size in the context of the Southeast Asian *Ranatra* assemblage. Within any given population, males are noticeably smaller than females, and represent the smallest species of *Ranatra* occurring in Peninsular Malaysia and adjacent Greater Sunda Islands.

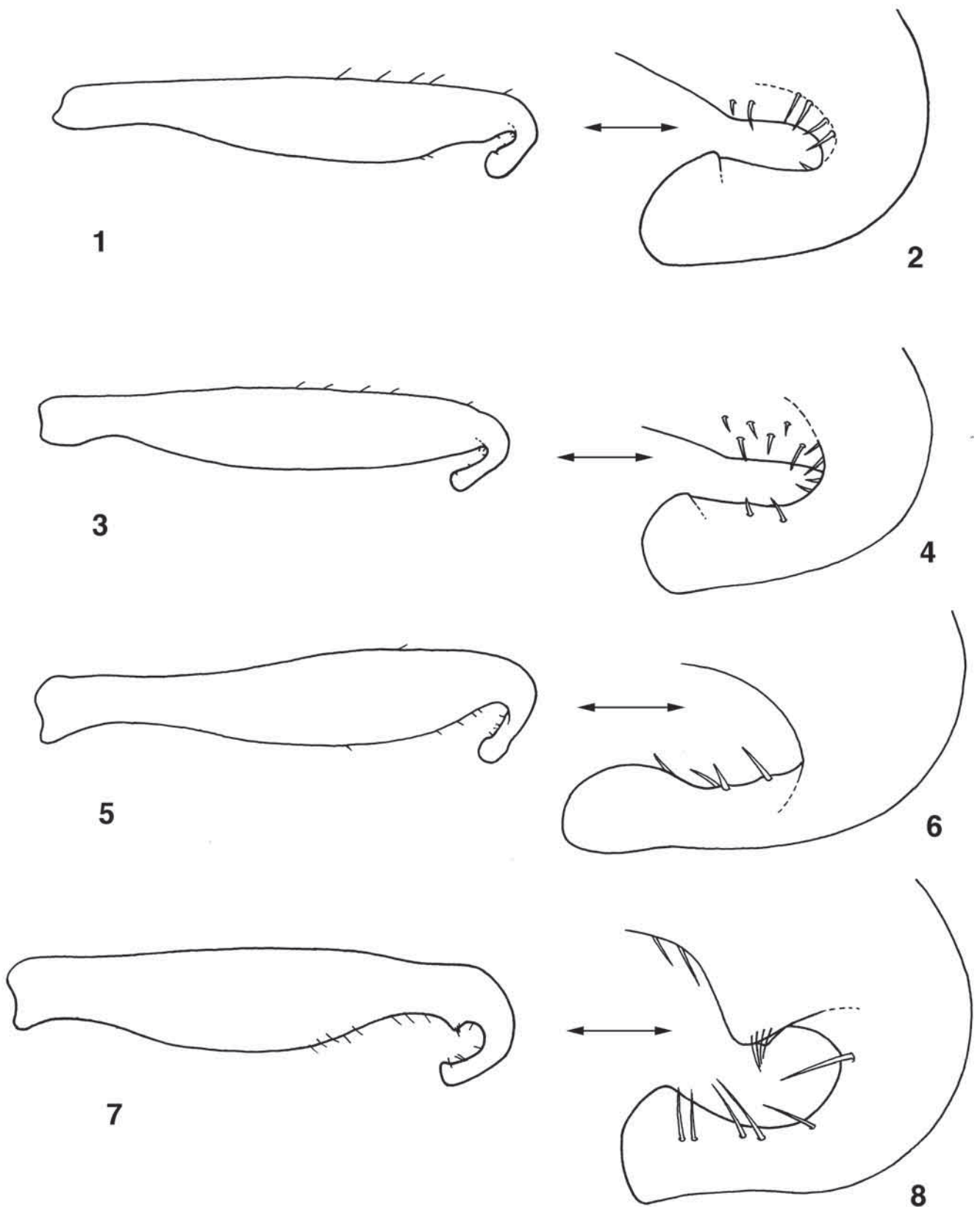
**Distribution.** — Southern Peninsular Malaysia (Johor), Singapore, Sumatra, Borneo, Java, Bali, southwestern peninsula of Celebes (Sulawesi Tenggara).

### *Ranatra thai* Lansbury, new status

(Figs. 5, 6)

*Ranatra longipes thai* Lansbury, 1972: 334.

**Material examined.** — **MALAYSIA:** **Terengganu:** 3 males, 1 female, pool at Km. 94 on road from Kuala Terengganu to Kota Bahru, south of Jerteh, 5°32'38.5"N, 102°43'43.9"E, water temp. 26°C, pH 6.7, coll. H. K. Lua, 19 Mar.1992 (ZRC). **Selangor:** 2 males, 2 females, Kuala Selangor and Nature Park, coll. Peter K. L. Ng, K. L. Yeo, Kang Nee & Jeffrey, 15 May 1991 (ZRC.6.15756–15759); 1 male, 2 females, 1 immature, Kuala Selangor, coll. H. H. Tan & S. H. Tan, Sep.1993 (ZRC.6.22232); 1 male, Selangor Templer Park Lake, coll. D. Kovac, 23 Nov.1995 (ZRC.6.22229); 2 males, 1 female, 2 immatures, Kuala Selangor, site 48, coll. H. H. Tan & S. H. Tan, Sep.1993, Y844 (ZRC); 6 males, 3 females, Sabak Bernam, 43 km to Sg. Besar from Tg. Malim, coll. T. B. Lim, 12 Dec.1994, (ZRC.6.22233); 1 male, 1 immature, Selangor peat swamp forest, coll. H. H. Tan et al., 25 Mar.1994 (ZRC); 13 males, 3 females, pond at Templer Park, N. of Kuala Lumpur, coll. D. A. & J. T. Polhemus, 17 Aug.1985, CL 2071 (JTPC). **Pahang:** 1 male, 1 female, 71 km to Kuantan, coll. B. Tan & G. Sumita, 15 May 1995, TG01 (ZRC.6.22218); 1 male, Kuala Lipis, pool by mud track, coll. K. L. Yeo, 12 Apr.1997, YKL901M (ZRC.6.22214); 3 males, 4 females, pond 54 km SW of Kuantan, coll. D. A. & J. T. Polhemus, 22 Aug.1985, CL 2285 (JTPC). **Malacca:** 8 males, 2 females, Rembia Stream, coll. Fernando, 8 Apr.1960 (JTPC);



Figs. 1–8. *Ranatra* species, male left parameres with details of paramere apex. 1, 2: *R. longipes longipes*, specimen from Indonesia, Borneo, East Kalimantan (CL 2092). 3, 4: *R. longipes longipes*, specimen from Singapore, Nee Soon Swamp Forest (Y843). 5, 6: *R. thai*, specimen from Thailand, Chiang Mai Prov (CL 2201). 7, 8: *R. rafflesi*, specimen from Singapore, Seletar Reservoir (TAD0830).

**Johor:** 1 male, Kulai, coll. H. K. Lua, 10 Jul.1998, LHK0416 (ZRC.6.22210); 2 males, Pontain stream at the palm estate along the trunk road to Pekan nanas, coll. H. K. Lua, 15 Aug.1985, LHK9548 (ZRC.6.22220). VIETNAM: **Quang Tri Prov.:** 3 males, 3 females, 1 mi. N. of Quang Tri, coll. A. R. Gillogly, 10 Jun.1970, sewage pond (JTPC). **Phu Yen Prov.:** 6 males, 5 females, stream in granite hills on N. side of Ca Pass, 29 km S. of Tuy Hoa on Hwy. 1, 60 m, 12°53'05"N, 109°23'38"E, water temp. 24°C, coll. D. A. Polhemus, J. T. Polhemus & P. Nguyen, 25 Mar.2001, CL 4316 (JTPC). **Cao Bang Prov.:** 1 male, 2 females, stream in rice paddies, 17 km N. of Bac Kan, 205 m [675 ft], water temp. 20°C., coll. J. T. Polhemus & P. Nguyen, 19 Mar.2000, CL 4362 (JTPC). **Binh Dinh Prov.:** 4 males, 5 females, Bala River, on E. side of An Khe Pass, 29 km E. of An Khe on Hwy. 19, 55 m, 13°56'58"N, 108°50'39"E, water temp. 24°C, coll. J. T. Polhemus & P. Nguyen, 12 Mar.2001, CL 4290 (JTPC). **Quang Ngai Prov.:** 5 males, Song Re River at bridge, 114 km NE of Kontum on Hwy. 24, 120 m, 14°44'23"N, 108°33'43"E, water temp. 27.5°C, coll. D. A. Polhemus, J. T. Polhemus & P. Nguyen, 18 Mar.2001, CL 4300 (JTPC). **Gia Lai Prov.:** 4 females, Voi River, 2.5 km N. of An Khe on Kanat road, 430 m, 13°59'15"N, 108°40'54"E, water temp. 24°C, coll. J. T. Polhemus & P. Nguyen, 14 Mar.2001, CL 4295 (JTPC). **Dong Nai Prov.:** 2 males, 3 females, Nam Cat Tien National Park, Muoi Que stream, coll. H. H. Tan et al., 7 May 2001, THH0121 (ZRC); 1 male, 4 females, Nam Cat Tien National Park, Trai River, coll. H. H. Tan et al., 11 May 2001, THH0130 (ZRC). THAILAND: **Chiang Mai Prov.:** 2 males, 1 female, Fang Dist., ponds at Fang Horticultural Station, 500 m, coll. J. T. & D. A. Polhemus, 15 Nov.1985, CL 2201 (JTPC); 5 males, 10 females, stream 10 km NW of Mae Rim, coll. D. A. & J. T. Polhemus, 19 Nov.1985, CL 2204 (USNM).

**Discussion.** — Lansbury (1972) described the subspecies *Ranatra longipes thai* based on specimens from various localities in Thailand. Our analysis of male paramere structure clearly indicates that whereas specimens of nominate *R. longipes longipes* from Singapore, Java and Borneo share common character states, including an incipient subapical tooth on the inner margin of the apical hook of the paramere and numerous small spinules along the inner circumference of this hook (Figs. 1–4), specimens from Thailand corresponding to Lansbury's subspecies have a more rounded and expanded tip on the apical hook, lack the incipient tooth, and possess a different and more limited pattern of spinules (Figs. 5, 6). On the basis of these differences, we herein elevate *Ranatra longipes thai* to full species status.

In addition to specimens from Thailand, the majority of the material previously assigned to *R. longipes* that we have examined from Peninsular Malaysia, with the exception of certain samples from Johor, in fact represents *R. thai*. By contrast, *R. longipes* was described from Java, and we have also seen specimens of this species from Singapore, Sumatra, Borneo, and the southern extremity of the Peninsular Malaysia. It therefore appears that *R. longipes* is a predominantly insular species occurring on the Greater Sunda Islands and immediately adjacent smaller islands, whereas *R. thai* is confined to continental Southeast Asia.

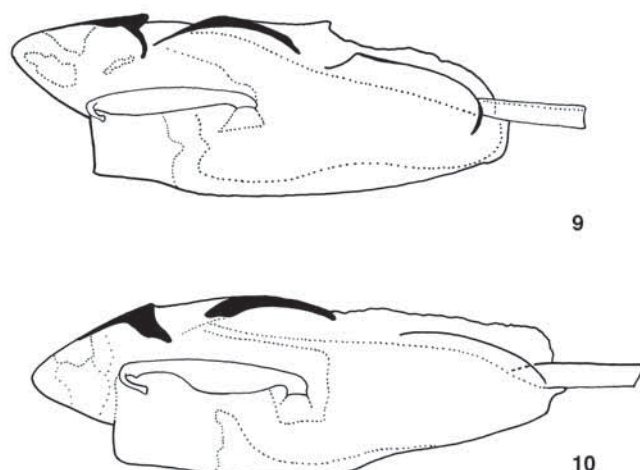
**Distribution.** — Thailand, Vietnam, Peninsular Malaysia.

### *Ranatra rafflesi*, new species

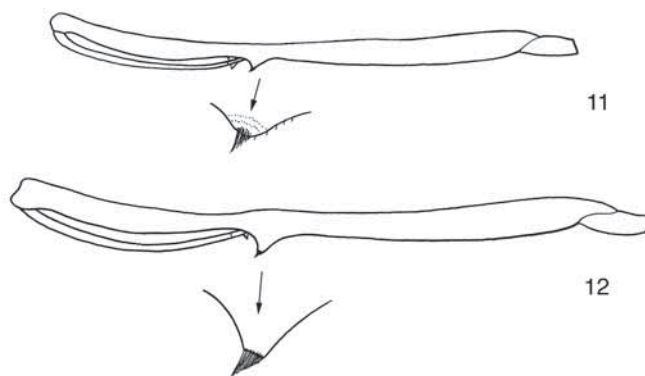
(Figs. 7, 8, 10, 12–15)

**Type material examined.** — Holotype, male, Upper Seletar Reservoir, coll. Tran A. D. & A. Lok, 27–28 May 2008, TAD0830 (ZRC, dry mounted).

Paratypes (alcohol preserved unless otherwise stated): SINGAPORE: 1 male, 1 female, same data as holotype (BPBM); 1 male, 1 female, Nee Soon, coll. K. L. Yeo, 19 Sep.1991, #Y771 (ZRC); 1 female, Murai Reservoir, coll. Tran A. D., 20 May 2008, TAD0822 (ZRC); 1 female, Murai Reservoir, coll. Tran A. D., 26 Aug.2008, TAD0855 (ZRC); 2 females, Murai Reservoir, coll. Tran A. D., 15 Jul.2008, TAD0847 (ZRC); 1 female, Murai Reservoir, 8 May 2007, coll. unknown (ZRC); 1 female, Upper Seletar Reservoir, coll. Tran A. D. & A. Lok, 26 May 2008, TAD0828 (ZRC); 1 female, Upper Seletar Reservoir, coll. Tran A. D. & A. Lok, 23 May 2008, TAD0827 (ZRC); 1 male, Nature Reserve Survey, Seletar Reservoir, Mandai Rd., coll. H. K. Lua et al., 16 May 1994, NS134B (ZRC, dry mounted); 1 male, Nature Reserve Survey, Seletar Reservoir, Mandai Rd., coll. H. K. Lua et al., 17 May 1994, NS136B (ZRC, dry mounted); 1 male, Upper Peirce Reservoir, coll. Tran A. D., 18 Apr.2008, TAD0816 (ZRC, dry mounted); 2 males, Nature Reserve



Figs. 9, 10. *Ranatra* species, male phallotheca, left lateral view. 9: *R. longipes longipes*, specimen from Singapore, Nee Soon Swamp Forest (Y843). 10: *R. rafflesi*, specimen from Singapore, Upper Seletar Reservoir (TAD0830).

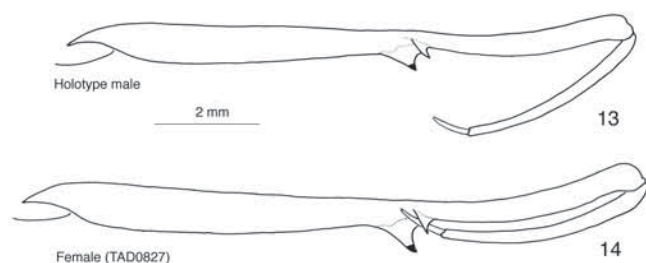


Figs. 11, 12. *Ranatra* species, left foreleg, outer lateral view. 11: *R. longipes longipes*, male specimen from Singapore, Nee Soon Swamp Forest (Y843). 12: *R. rafflesi*, specimen from Singapore, Upper Seletar Reservoir (TAD0830).



Survey, Lorong Banir, coll. T. B. Lim et al., 24 May 1994, NS141C (ZRC, dry mounted); 1 male, MacRitchie Catchment Reservoir, coll. K. L. Yeo et al., 21 Apr.1994, NS124A&B (ZRC, dry mounted); 1 male, Pulau Tekong Reservoir, coll. C. M. Yang, 27 Nov.2001, YCM272 (ZRC); 1 male, 1 female, Pulau Tekong Reservoir, coll. Tran A. D., 26 Sep.2007, TAD0709 (ZRC); 1 female, Pulau Tekong Reservoir, coll. Tran A. D. & A. Lok, 30 Jul.2008, TAD0850 (ZRC). INDONESIA: **Riau Islands Prov.**: 5 males, Batam, coll. C. M. Yang et al., 29 Jan.1992 (ZRC.6.15699–15703); 1 male, Pulau Batam, southeast, covered, coll. H. H. Tan, S. H. Tan & H. H. Ng, 5 Sep.1994 (ZRC): 1 male, 2 females, Riau, Pulau Bintan North, coll. H. K. Lua, 26 Jun.1995, LHK259 (ZRC); 1 male, 1 female, Pulau Bintan, coll. H. H. Tan, 30 Jun.1995, THH9542 (ZRC).

**Description.** — General colouration: dark brown, legs paler, lacking distinct annulations but with faint yellowish patches on fore femora.



Figs. 13, 14. *Ranatra rafflesi*, left foreleg, inner lateral view. 12: Male (holotype, TAD0830). 13: Female, specimen from Singapore, Upper Seletar Reservoir (TAD0827).

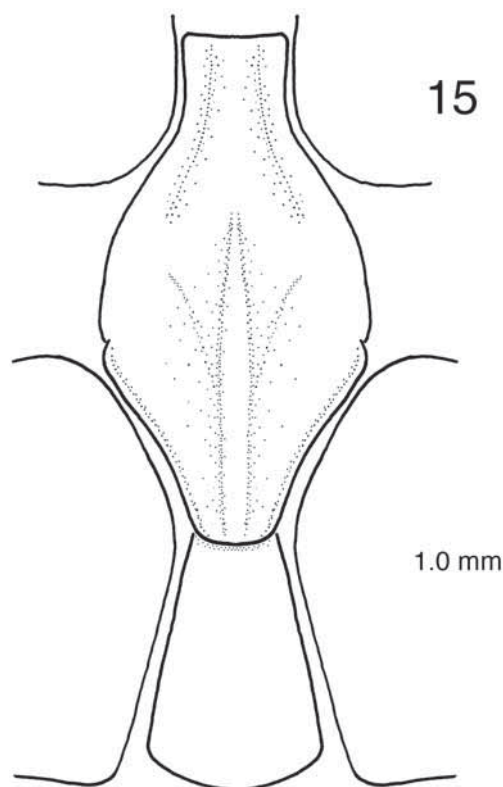


Fig. 15. *Ranatra rafflesi*, male, metasternum, specimen from Singapore, Upper Seletar Reservoir (NS136B).

Measurements: Males: body length 21.5–24.0 (holotype: 24.0); length of siphon 19.0–22.5 (holotype: 22.5), width of head 2.49–2.70 (holotype: 2.70); width of eye 0.82–0.91 (holotype: 0.90); interocular width 0.82–0.91 (holotype 0.91); anterior width of pronotum 1.62; humeral width of pronotum 2.18; length of anterior lobe along median line 3.72; length of posterior lobe along median line 1.91; fore leg: length of coxa 6.50, of femur 10.10; middle leg: length of femur 14.50, of tibia 16.50; hind leg: length of femur 14.50, of tibia 17.0. Females: body length 25.0–29.0; length of siphon 20.0–24.0; width of head 3.10; width of eye 1.00; interocular width 1.05; anterior width of pronotum 1.96; humeral width of pronotum 2.49; length of anterior lobe along median line 4.60; length of posterior lobe along median line 2.25; fore leg: length of coxa 8.10, of femur 12.0; middle leg: length of femur 16.5, of tibia 19.0; hind leg: length of femur 16.5, of tibia 19.25.

Head: Brown, with vertex clearly raised above eyes into low, conical tumescence; eyes red, width subequal to width of vertex; frons triangular; tylus raised, longitudinally tumescent; lora swollen, raised above clypeus, bearing scattered long, slender, golden setae; clypeus lacking apical nodules, bearing short, stout, pale setae along longitudinal midline, similar setae also present apically on tylus; second segment of antennae with long, finger-like projection, slightly shorter in length than segment III.

Thorax: Dark brown; prothorax in lateral view subequal in length to fore coxa; anterior lobe slightly over twice as long as posterior lobe when measured along longitudinal midline; anterior margin very slightly raised when viewed laterally; ratio of humeral width/anterior width 1.35 (male), 1.27 (female); pronotal grooves weakly developed; anterior margin when viewed ventrally nearly straight, anteroventral angles not produced; posterior lobe with humeri slightly tuberculate. Scutellum 1.7× longer than wide, posterior section with a pair of roughly circular subapical depressions, one on each side of midline. Mesosternum broadly domed, anterior margin weakly bisinuate medially, not raised, narrow posterior projection between mid-coxae truncate and deeply grooved along midline; metasternum with strongly raised longitudinal carina on posterior half, posterior margin truncate (Fig. 15); space between middle and hind coxae subequal to diameter of coxae.

Legs: Pale yellowish brown, without distinct annulations or mottling. Fore femur with a median tooth, width of femur across larger tooth about equal to or slightly larger than maximum width of femur in basal half (Figs. 12–14), a second smaller tooth present immediately anterior to median tooth on inner face of femur; ratio of width of femur across larger tooth/width of femur at basal half: 1.04–1.21 (holotype 1.04); ratio of width of femur across larger tooth/width at base of larger tooth at proximal side: males 1.78–2.15 (holotype 1.78), females 2.10–2.47; ratio of femur across larger tooth/width at base of larger tooth at distal side: males 2.36–2.61 (holotype 2.40), females 2.52–3.00. Lengths of middle and hind femora subequal; hind femur clearly surpassing tip of operculum.

Middle and hind tibiae each longer than respective femora; middle and hind femora both bearing fringe of long, slender, pale setae on posterior margins along their entire length. Hind femur when folded back along the body extending beyond tip of abdomen (excluding siphon) in males, reaching tip of abdomen in females.

Abdomen: Male operculum as long as connexivum. Female operculum reaching base of respiratory siphon.

Male genitalia: Paramere tapering along distal one third, with apical hook open and evenly curved, bearing a broadly triangular tooth along inner margin before hook, apex expanded (Figs. 7, 8); phallosome as in Fig. 10.

**Etymology.** — The epithet “*rafflesi*” is dedicated to Sir Stamford Raffles, the founder of Singapore, and also a naturalist who contributed greatly to our knowledge of the biodiversity of Singapore and the surrounding region.

**Distribution.** — Known at present from Singapore and nearby Indonesian islands (Bintan and Batam).

**Discussion.** — In the key by Lansbury (1972), *Ranatra rafflesi* runs to the couplet 10, and from here can be ambiguously keyed to either *R. malayana* or to couplet 11, because the width of the fore femur across the larger tooth is slightly larger than the widest part of the femur, whereas couplet 10 offers the choice of either “about the same as” (leading to couplet 11) or “clearly greater than” (leading to *R. malayana*). If one follows couplet 11, this new species will eventually key to the *R. longipes* species and subspecies complex in the *R. biroi* species group. We would note that the key of Lansbury (1972) is at this point out of date because subsequent to his revision, nine additional species of *Ranatra* have been described from China and Southeast Asia (Nieser & Chen, 1991; Nieser, 1996, 1997; Zettel, 1999; Chen et al., 2004).

The male paramere structure of *Ranatra rafflesi* is very similar to that of *R. malayana* Lundblad, 1933, particularly with regard to the flared apex of the distal hook, but this new species can be separated from the latter by both the length of the hind femur, and the width of fore femur across its larger tooth. According to the description by Lansbury (1972) the hind femur in both sexes of *R. malayana* extends beyond the posterior margin of the wing membrane but does not reach the tip of the operculum, while in *R. rafflesi* it reaches or exceeds the tip of the abdomen in both sexes.

Lansbury (1972) tentatively treated *Ranatra malayana* as a species group by itself. Nieser (1997) subsequently described *Ranatra katsara*, placed it into the *R. malayana* species group, and formally defined this species group. Based on the characters provided by Lansbury (1972) and Nieser (1997), the *R. malayana* species group differs from the *R. biroi* species group in the length of the respiratory siphon (which in the *R. malayana* group is equal to or longer than the length of the body, while in the *R. biroi* group it is

shorter than the length of the body); the eye width (which in the *R. malayana* group is less than the interocular space, while in the *R. biroi* group it is equal to or greater than the interocular space); and by the size of larger tooth of fore femur (in the *R. malayana* group the width of the fore femur across the larger tooth is much greater than the widest part of the femur proximally, while in the *R. biroi* group the width of the fore femur across the larger tooth is about the same as widest part of the femur proximally). We would note that the phylogenetic validity of the *Ranatra* species groups proposed by Lansbury (1972) and Nieser (1997) has never been evaluated, and that Lansbury’s *R. biroi* species group in particular may prove to be polyphyletic.

Based on these definitions, *Ranatra rafflesi* clearly falls into the *R. biroi* group, and appears most closely related to *R. natunaensis* Lansbury, 1972 from Natuna Island (off the west coast of Borneo), which has a similar paramere structure. It can be separated from *R. natunaensis* by the longer hind femora, which exceed the tip of the abdomen (excluding the respiratory siphon) in males and reach its posterior apex in females, and by the wider space between the middle coxa. By contrast, in *R. natunaensis* the hind femur in both sexes reaches about one third of the way along the operculum, and middle coxae are closely appressed, with their inner margins nearly contiguous.

*Ranatra rafflesi* also may be separated from the superficially similar *R. longipes longipes* and *R. thai* by the more open curve in the process at the apex of the male paramere (compare Figs. 1–6 with 7, 8), the more acute dorsal margin of the sclerotized distal section of the male phallosome when viewed laterally (compare Figs. 9, 10), the larger, more truncate tooth on the fore femur (compare Figs. 11, 12), and the longer hind femur (in *R. longipes longipes* the hind femur reaches slightly beyond tip of operculum). In addition, females of *R. rafflesi* can be separated from *R. longipes longipes* by the distinctly larger ratio of the width of the fore femur across its larger tooth to the width at the base of the larger tooth on the proximal side (in *R. rafflesi* 2.10–2.47, in *R. longipes longipes* 1.70–1.83) and to the width at the base of the larger tooth on the distal side (in *R. rafflesi* 2.52–3.00, in *R. longipes longipes* 2.05–2.40).

## ACKNOWLEDGEMENTS

We sincerely thank Prof. Peter K. L. Ng, Mrs. Yang Chang Man, and Ms. Lua Hui Kheng of the Raffles Museum of Biodiversity Research, National University of Singapore for providing generous logistical support to the authors during several visits to Singapore for work in the collections held there; to Dr. Thomas Henry of the USDA Systematic Entomology Laboratory, at the Smithsonian Institution’s National Museum of Natural History in Washington, DC, who provided the second author access to collections under his care; and to Dr. John T. Polhemus, Englewood, Colorado for useful comments on early drafts of this manuscript.

# LITERATURE CITED

- Chen, P.-p., N. Nieser & J.-z. Ho, 2004. Review of the Chinese Ranatrinae (Hemiptera: Nepidae), with descriptions of four new species of *Ranatra* Fabricius. *Tijdschrift voor Entomologie*, **147**: 81–102.
- Chen, P.-p., N. Nieser & H. Zettel, 2005. *The Aquatic and Semi-Aquatic Bugs (Heteroptera: Nepomorpha & Gerromorpha) of Malesia*. Fauna Malesiana Handbook 5. Brill, Leiden, Boston. ix + 546 pp.
- Fernando, C. H. & L. Cheng, 1974. A preliminary study of the fauna and distribution of aquatic Hemiptera in Malaya and Singapore. *Federation Museums Journal*, **19**: 21–44.
- Lansbury, I., 1972. A review of the Oriental species of *Ranatra* Fabricius (Hemiptera–Heteroptera: Nepidae). *Transactions of the Royal Entomological Society of London*, **124**: 287–341.
- Lundblad, O. M., 1933. Zur Kenntniss der aquatilen und semiaquatilen Hemipteren von Sumatra, Java und Bali. *Archiv für Hydrobiologie Supplementum*, **12**: 1–195, 263–489.
- Nieser, N., 1996. Two new species of *Ranatra* Fabricius from Southeast Asia (Insecta: Heteroptera: Nepidae). *Annalen des Naturhistorischen Museums in Wien*, **98B**: 347–351.
- Nieser, N., 1997. A new species of *Ranatra* from Thailand (Insecta: Heteroptera: Nepidae). *Annalen des Naturhistorischen Museums in Wien*, **99B**: 79–82.
- Nieser, N. & P.-p. Chen, 1991. Naucoridae, Nepidae and Notonectidae, mainly from Sulawesi and Pulau Buton (Indonesia). *Tijdschrift voor Entomologie*, **134**: 47–67.
- Nieser, N. & P.-p. Chen, 1999. Sixteen new species of Nepomorpha (Heteroptera) mainly from Sulawesi (Indonesia). *Tijdschrift voor Entomologie*, **142**: 77–123.
- Nieser, N., P.-p. Chen & C. M. Yang, 2005. A new subgenus and six new species of Nepomorpha (Insecta: Heteroptera) from Yunnan, China. *Raffles Bulletin of Zoology*, **53**(2): 189–209.
- Stål, C., 1861. Nova methodus familias quasdam Hemipterorum disponendi. *Öfversigt af Kungliga Vetenskaps-akademiens Forhandlingar*, **18**(4): 195–212.
- Zettel, H., 1999. *Ranatra libera* sp.n. (Heteroptera: Nepidae) from Burma. *Linzer biologische Beiträge*, **31**(1): 427–430.