



## EIGHT NEW SPECIES OF THE GENUS *NEMOURA* (PLECOPTERA: NEMOURIDAE) FROM THAILAND AND VIETNAM

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### ABSTRACT

Eight new species of *Nemoura* are proposed from specimens collected in Thailand and Vietnam. New species include *N. apicalis* sp.n., *N. clavaloba* sp.n., *N. magniseta* sp.n. *N. stylocerca* sp.n. and *N. tenuiloba* sp.n. from Vietnam, and *N. neospiniloba* sp.n., *N. raptoraloba* sp.n. and *N. spinacerca* sp.n. from Thailand. A provisional key for male *Nemoura* from Thailand and Vietnam is presented.

**Keywords:** *Nemoura*, Plecoptera, Nemouridae, Thailand, Vietnam, New species

### INTRODUCTION

*Nemoura* is a large, primarily Holarctic, stonefly genus with a significant Oriental component. Baumann (1975) provided the modern definition for the group and included a list of 91 species considered valid at that time. More recently, DeWalt et al. (2009) posted a list which includes 176 species; the great majority of these are western Palearctic, but 36 are reported for China. Mainland Chinese species include 10 proposed by Wu (1926, 1927, 1929, 1935, 1938, 1939, 1962, 1973), 13 described by Li & Yang (2006, 2007, 2008a, 2008b) and others described by various authors (Chu 1928; Du et al. 2008; Klapálek 1907; Sivec 1981; Ueno 1941; Wang et al. 2006; Zhu & Yang 2003). Currently none are recorded for Thailand or Vietnam.

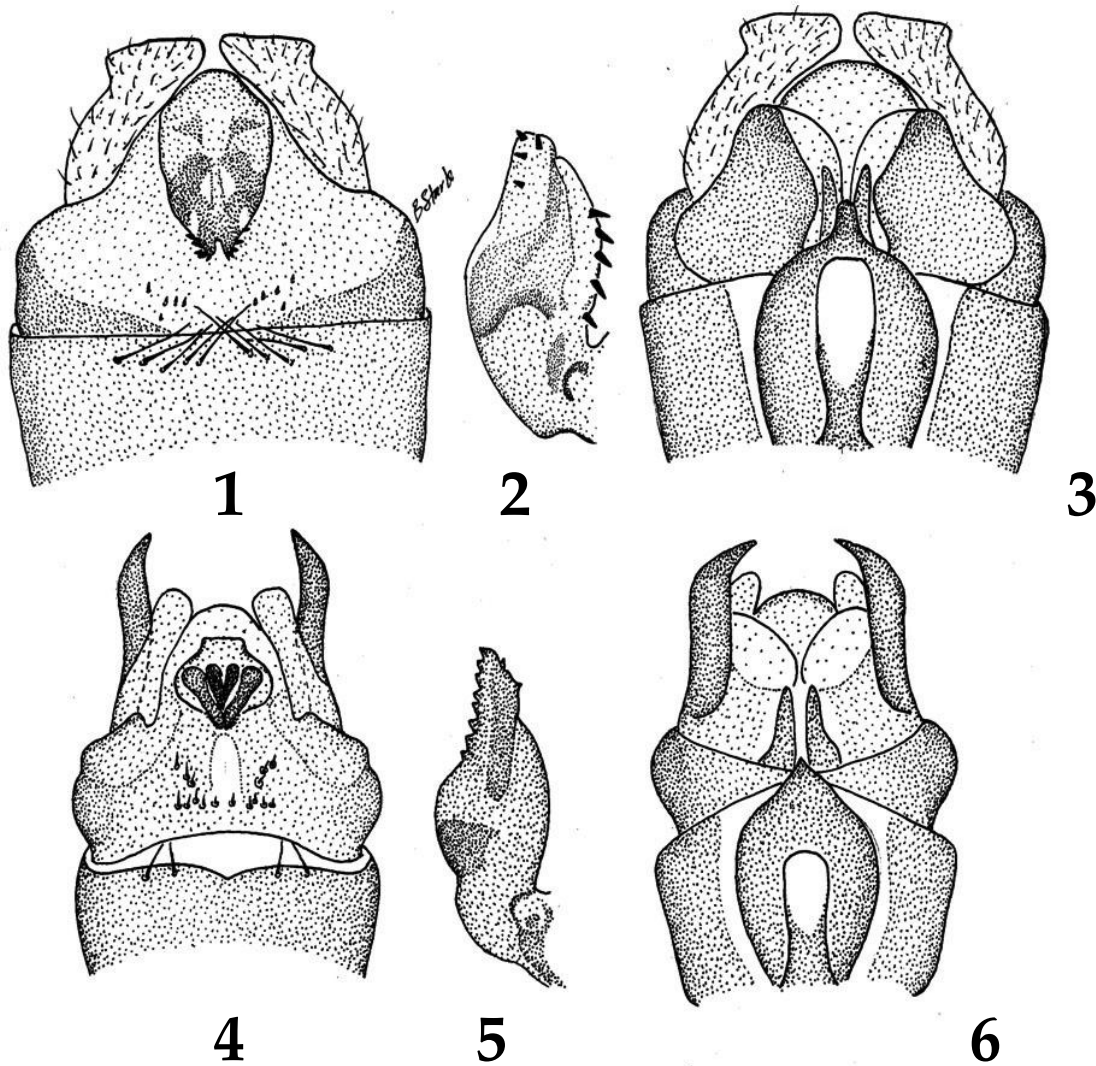
The present study is based on a small sample of adult *Nemoura* collected primarily in Malaise traps by Professor Dr. P. Chantaramongkol and members of the Chiang Mai University team, or by Dr. H. Malicky, Dr. W. Mey or personnel of the Royal Ontario Museum. The material includes eight species

which we regard as new. Specimens are deposited in the Slovenian Museum of Natural History, Ljubljana, Slovenia (PMSL), B.P. Stark collection, Clinton, Mississippi, U.S.A. (BPS), the Royal Ontario Museum, Toronto, Ontario, Canada (ROM) and the Zoological Museum der Universität-Humboldt, Berlin, Germany (ZMB) as indicated in the text. The following key will assist in identification of male specimens of *Nemoura* known for Thailand and Vietnam.

### RESULTS AND DISCUSSION

#### Provisional Key to Males of *Nemoura* from Vietnam and Thailand

- 1 Paraprocts in ventral aspect bearing a long, slender, acute lobe projecting to tips of cerci (Figs. 6, 15); cerci usually simple ..... 2
- 1' Paraprocts without projecting slender lobe (Figs. 3, 11); cerci modified with truncate or bilobed apices (Figs. 1, 11) ..... 4



Figs. 1-6. *Nemoura* male genitalia. *N. apicalis* (1-3), 1. Male terminalia, dorsal. 2. Epiproct, lateral. 3. Male terminalia, ventral. *N. clavaloba* (4-6), 4. Male terminalia, dorsal. 5. Epiproct, lateral. 6. Male terminalia, ventral.

- |    |  |                     |  |  |
|----|--|---------------------|--|--|
| 2  | Paraproct outer lobe club-shaped in lateral aspect; epiproct apex serrate in lateral aspect (Fig. 5) ..... | <i>clavaloba</i>    | 13); tergum 10 bearing sensilla basiconica and a cluster of spines near epiproct (Fig. 13) ..... | <i>raptoraloba</i>   |
| 2' | Paraproct outer lobe acute in lateral aspect (Fig. 14); epiproct apex not serrate (Figs. 13-14) .....      | 3                   | 4  | Cercal apices truncate in dorsal aspect (Fig. 1); tergum 9 with a mesal row of long setae .. |
| 3  | Epiproct somewhat quadrangular in dorsal aspect (Fig. 24); tergum 10 without spiny armature .....          | <i>tenuiloba</i>    | 4'   | Cercal apices variable but not truncate; tergum 9 without mesal row of long setae .....      |
| 3' | Epiproct margins convergent in apical half (Fig. 15); tergum 10 without spiny armature .....               | <i>neospiniloba</i> | 5  | Posterior margin of tergum 9 bearing a pair of spiny lobes (Fig. 9) .....                    |

- 5' Posterior margin of tergum 9 without spiny lobes (Fig. 7) ..... 6  
 6 Cerci in dorsal aspect with a small knob near midlength on outer margin and a stout seta on inner margin (Fig. 7) ..... *magniseta*  
 6' Cerci without small knob or stout seta ..... 7  
 7 Posterior margin of tergum 9 bearing patches of sensilla basiconica (Fig. 17); lateral aspect of cerci bearing a short, thick, relatively straight spine arising from midlength (Fig. 18) ..... *spinacerca*  
 7' Posterior margin of tergum 9 without sensilla basiconica (Fig. 21); lateral aspect of cerci bearing a long, anteroventrally curved spine arising from the posterior cercal margin (Fig. 22) .... *stylocerca*

*Nemoura apicalis* sp. n.  
 (Figs. 1-3)

**Material examined.** Holotype ♂ from Sapa, Fan Si Pang Mountains, Lao Cai Province, Vietnam, 25-30 March 1995, W. Mey (ZMB). Paratype: Vietnam: Tam Dao, 800-1000 m, 19 May-13 June 1995, H. Malicky, 1♂ (PMSL).

**Adult habitus.** General color pale brown. First and second antennal segment darker than the rest of antennae. Head dark brown. Legs faintly banded.

**Male.** Forewing length 7 mm. Posterior margin of tergum 9 with a row of ca. 4-8 long slender setae (Fig. 1); a few sensilla basiconica scattered on tergum 10. Epiproct short, broad basally in dorsal aspect and bearing a small apical notch (Fig. 1); apex bearing a cluster of ca. 4-8 spines giving apex a biserrate appearance in dorsal aspect; ventral sclerite bearing a double row of ca. 5 widely spaced, short spines (Fig. 2). Cercal apices curved outward at tip forming a truncate, foot shaped structure (Figs. 1, 3). Paraproct inner lobes slender and essentially parallel to one another, outer lobes large and triangular in outline; vesicle about 3 times long as wide (Fig. 3).

**Female.** Unknown.

**Larva.** Unknown.

**Etymology.** The name refers to the epiproct apex which in this species is notched and appears biserrate in dorsal aspect.

**Diagnosis.** The truncate cercal apices, biserrate epiproct apex and setal row on tergum 9 appear distinctive for this species which does not appear to be closely related to any known species.

*Nemoura clavaloba* sp.n.  
 (Figs. 4-6)

**Material examined.** Holotype ♂ and 8♂ paratypes from Tam Dao, 800-1000 m, Vinh Phu Province, Vietnam, 19 May-13 June 1995, H. Malicky (PMSL).

**Adult habitus.** General color brown. Basal antennal segment dark brown, next few segments pale and rest of antennal segments dark. Legs faintly banded.

**Male.** Forewing length 5 mm. Tergum 9 with a pair of long setae on each side of posterior margin; tergum 10 with a sparse median patch of short, thin setae (Fig. 4). Epiproct bearing a dorsoapical, blade-like process armed with tooth-like serrae (Fig. 5). Paraprocts bearing a sharply pointed, inwardly curved process in ventral aspect (Fig. 5), which appears club shaped in lateral aspect. Cerci simple.

**Female.** Unknown.

**Larva.** Unknown.

**Etymology.** The species name refers to the club shaped paraproct lobe.

**Diagnosis.** *Nemoura clavaloba* is similar in paraproct structure to *N. raptoraloba* and *N. tenuiloba*, both described below, and to *N. rotundprojecta* Du & Zhou (Du et al. 2008). However, the latter species has the acute process of the paraprocts curved strongly laterad and *N. clavaloba* is the only species of this group which has the extended paraproct lobe appearing clavate in lateral aspect, and also the only one in which the epiproct apex is strongly serrate on the dorsal margin (Fig. 5).

*Nemoura magniseta* sp. n.  
 (Figs. 7-8)

**Material examined.** Holotype ♂ from Sapa, Fan Si Pang Mountains, Lao Cai Province, Vietnam, 25-30 March 1995, W. Mey (ZMB).

**Adult habitus.** General color brown. Basal antennal segment pale, second antennal segment dark brown, rest of antennae uniformly brown. Head dark brown. Pronotum brown with some darker rugosities. Legs uniformly pale brown.

**Male.** Forewing length 6 mm. Terga 9-10 without conspicuous setation. Epiproct slightly longer than wide and bears two pairs of slender apical lobes (Fig. 7); slender, straight inner lobes extend beyond outwardly directed, and more heavily sclerotized



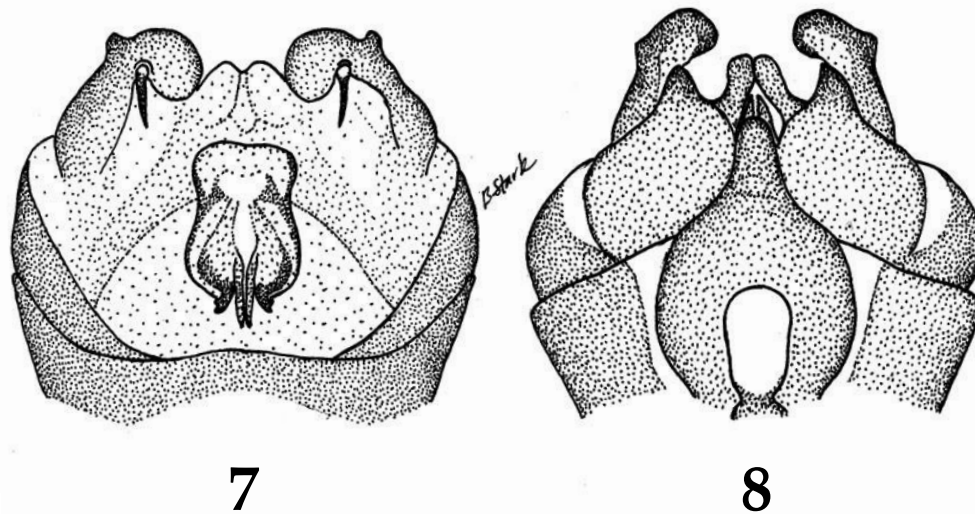


Fig. 7-8. *Nemoura magniseta*. 7. Male terminalia dorsal. 8. Male terminalia, ventral.

lateral lobes. Outer paraproct lobe large, unarmed, but with a small mesoapical projection; inner lobes small and unarmed (Fig. 8). Cercal segments curved strongly inward; sclerotized outer margins bear a low knob in basolateral third; inner margins bear a single prominent seta at midlength. Vesicle of moderate length; greatest width near apex (Fig. 8).

**Female.** Unknown.

**Larva.** Unknown.

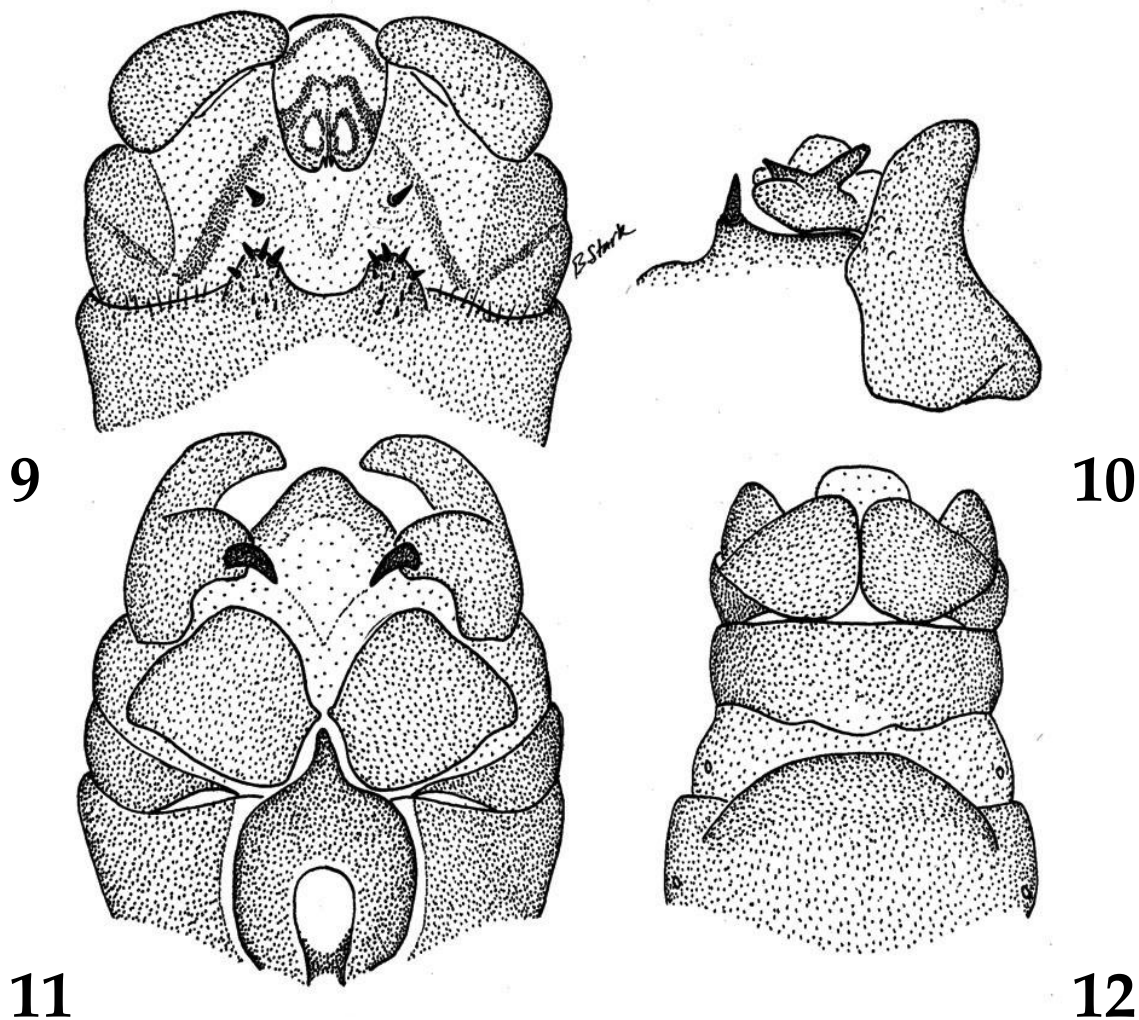
**Etymology.** The species name refers to the enlarged inner marginal cercal seta.

**Diagnosis.** This species appears distinct from others in the genus by virtue of the enlarged, spine-like seta projecting from the inner cercal margin and by the small rounded knob on the outer cercal margin (Fig. 7). The thick setal-like projection on the ventral cercal margin suggests this species is a member of the *Cercispinosa* Complex recognized by Baumann (1975).

*Nemoura neospiniloba* sp.n.  
(Figs. 9-12)

**Material examined.** Holotype ♂ from Huang Sai Lueng, 98° 27' N, 18° 31' E, 1060 m, Doi Inthanon National Park, Chiang Mai Province, Thailand, 4 April-3 May 2003, Malaise Trap (PMSL). Paratypes: Thailand: Chiang Mai Province, Doi Inthanon

National Park, 1200 m, Bang Khun Klang, 98° 32' N, 18° 32' E, 29 May-5 June 1989, P. Chantaramongkol, H. Malicky, 1♂ (PMSL). Same site, 8-15 May 1989, 2♂, 2♀ (PMSL). Same site, 3-10 July 1989, 26♂, 21♀ (PMSL). Same site, 5-12 July 1989, 3♂, 3♀ (PMSL). Same site, 10-17 July, 1989, 22♂, 22♀ (PMSL). Same site, 17-26 July 1989, P. Chantaramongkol, H. Malicky, 3♂, 5♀ (PMSL). Same site, 19-26 July 1989, 14♂, 10♀ (BPS). Same site, 6-13 August 1988, 1♂, 4♀ (PMSL). Same site, 4-11 September 1988, 2♂, 5♀ (BPS). Same site, 12-19 September 1989, 3♂, 2♀ (PMSL). Same site, 25 September-8 October 1988, 1♂ (PMSL). Phitsanulok Province, Phu Hin Rongkla National Park, Waterwheel Falls, 101° 00' N, 16° 59'E, 1280 m, 10-11 April 2003, Blacklight Trap, 1♂ (PMSL). Phitsanulok Province, Phu Hin Rongkla National Park, Huai Man Daeng Noi, 1600 m, 101° 03' N, 16° 57' E, 20 May-21 June 2002, 13♂ (BPS). Same site, 20 July-23 August 2002, 1♂ (PMSL). Same site, 21 October-16 November 2002, 1♂ (PMSL). Same site, 14 November-14 December 2002, 3♂ (PMSL). Same site, 17 December 2002-17 January 2003, 10♂ (PMSL). Same site, 10 January-10 February 2003, 5♂ (PMSL). Same site, 10 February-17 March 2003, 6♂ (PMSL). Same site, 5 April-5 May 2003, 4♂ (PMSL). Same site, 5 May-5 June 2003, 12♂ (PMSL).



Figs. 9-12. *Nemoura neospiniloba*. 9. Male terminalia, dorsal. 10. Male left cercus, tergum 10 and epiproct, lateral. 11. Male terminalia, ventral. 12. Female terminalia, ventral.

**Adult habitus.** General color brown to dark brown. First and second segment of antennae slightly darker than the rest of antennae. Head and pronotum uniformly brown. Legs faintly banded.

**Male.** Forewing length 6 mm. Posterior margin of tergum 9 bears a pair of rounded, spinulose lobes and tergum 10 bears a pair of small spines set on low knobs on either side of epiproct (Figs. 9-10). Epiproct short, wide, apically notched with a pair of minute processes set in the notch; apices of dorsal surface armed with small scale-like spines; ventral sclerite without obvious armature. Cerci bilobed in ventral

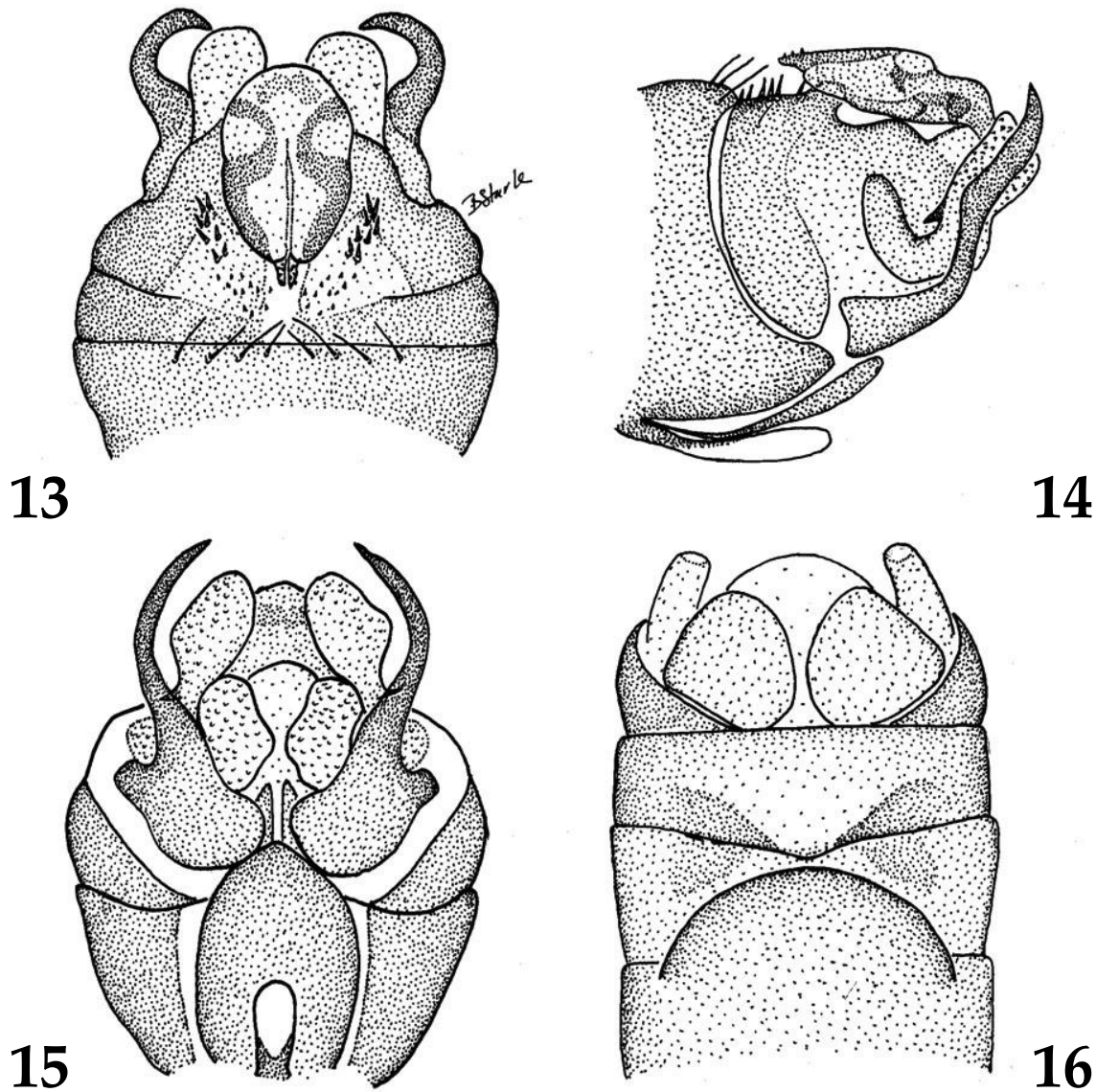
aspect (Fig. 11); ventral lobe with a prominent, inwardly curved apical spine. Vesicle about twice as long as wide (Fig. 11). Paraprocts simple and without armature; inner lobes small, not shown in Fig. 11; outer lobes large and subtriangular with rounded apices.

**Female.** Forewing length 8 mm. Sternum 7 produced into a truncate lobe which covers about half of sternum 8 (Fig. 12). Sternum 8 mostly membranous and without posterior projection.

**Larva.** Unknown.

**Etymology.** The species name refers to the pair of



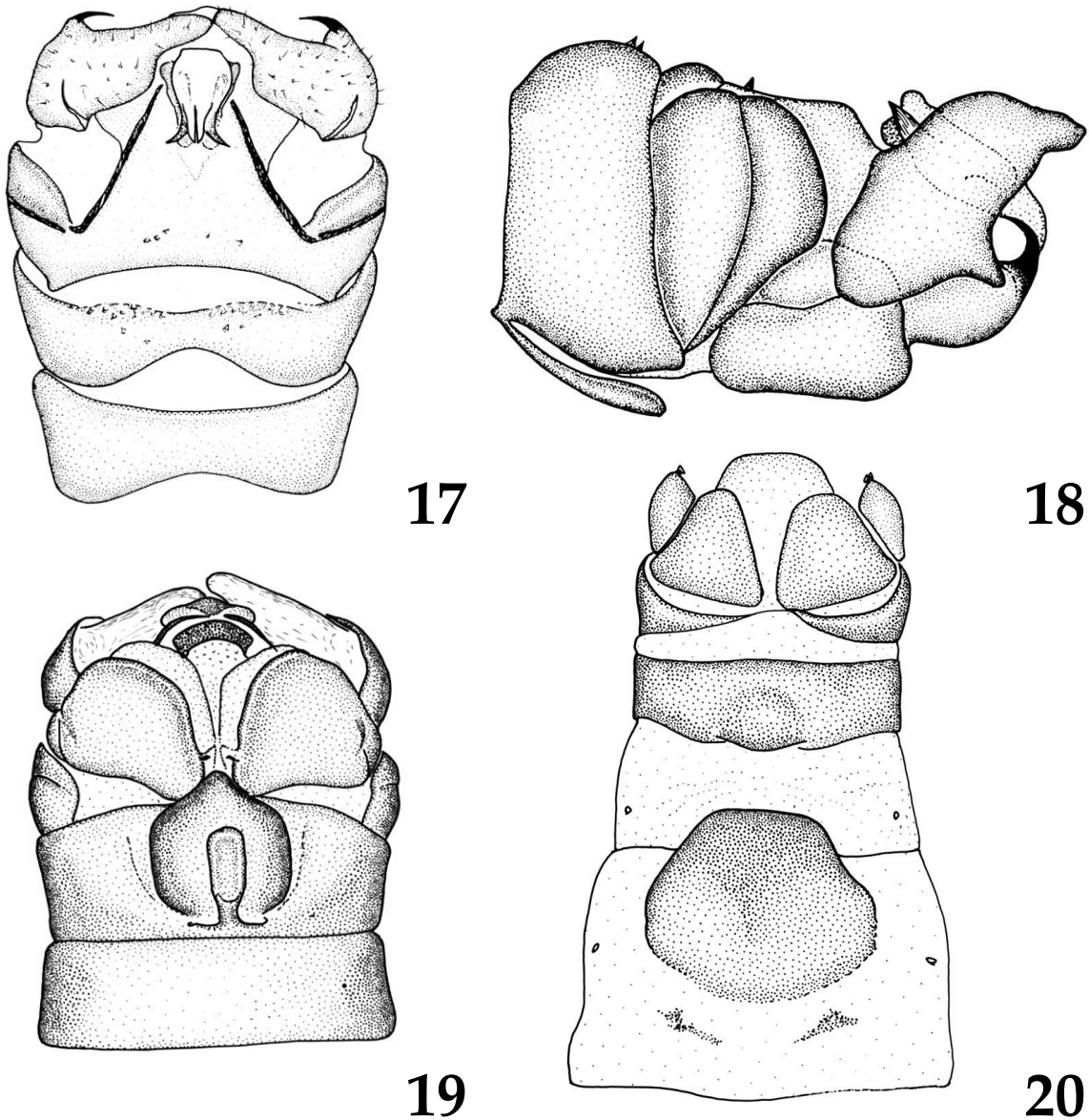


Figs. 13-16. *Nemoura raptoraloba*. 13. Male terminalia, dorsal. 14. Male terminalia, lateral. 15. Male terminalia, ventral. 16. Female terminalia, ventral.

spiny lobes on the mesoposterior margin of tergum 9. The prefix has been added to distinguish this name from that of *N. spiniloba* Jewett.

**Diagnosis.** *Nemoura neospiniloba* is similar in tergum 9 structure to *N. mucronata* Li & Yang and *N. furcocalda* Wu (Li & Yang 2008b). In the former species, the lobes on tergum 9 are acute and bear a

single large apical spine and the paraprocts have a distinct, but small, club-shaped inner lobe. The lobes on tergum 9 are separated by about twice their width in *N. furcocalda* and the epiproct apex in that species is distinctly trilobed. The species is tentatively placed in the *Cercispinosa* Complex recognized by Baumann (1975).



Figs. 17-20. *Nemoura spinacerca*. 17. Male terminalia, dorsal. 18. Male terminalia, lateral. 19. Male terminalia, ventral. 20. Female terminalia, ventral.

***Nemoura raptoraloba* sp.n.**  
(Figs. 13-16)

**Material examined.** Holotype ♂ and 1♀ paratype from Bang Khun Klang, 98° 32' N, 18° 32' E, 1200 m, Doi Inthanon National Park, Chiang Mai Province, Thailand, 26 January 1990, P. Chantaramongkol, H. Malicky (PMSL). Additional Paratypes: Thailand:

Chiang Mai Province, Doi Inthanon National Park, CP1TF, 98° 31' N, 18° 31' E, 1600 m, 26 March 1992, H. Malicky, 1♀ (PMSL). Chiang Mai Province, Doi Inthanon National Park, stream on right below check point, 1500 m, 11 April 1989, 1♂ (PMSL). Chiang Mai Province, Doi Suthep-Pui National Park, Huai Kaew above Monthatarn, 98° 55' N, 18° 49' E, 800 m, 14 February-11 March 2003, Malaise Trap, 1♂ (PMSL).

**Adult habitus.** General color pale brown. Head and pronotum without distinctive pigment pattern. Palpi and basal antennal segment pale. Femora with mesal and apical dark bands; tibiae with dark proximal marking. Forewings bearing scattered irregularly shaped pale areas against a slightly darker background.

**Male.** Forewing length 6.5 mm. Posterior margin of tergum 9 with a row of 5-8 long setae (Fig. 13); tergum 10 with a patch of sensilla basiconica on either side of epiproct tip, and a pair of prominent clusters of triangular spines set on sclerite adjacent to epiproct near apical third. Epiproct somewhat triangular in dorsal aspect, with a pair of thin, spine covered processes projecting at apex (Fig. 13). Paraproct outer lobe with a slender and strongly curved outer spine (Figs. 13-15). Cerci globular. Vesicle about twice as long as wide (Fig. 15).

**Female.** Forewing length 8.5 mm. Sternum 7 broadly rounded and overlapping basal half of sternum 8 (Fig. 16).

**Larva.** Unknown.

**Etymology.** The species name refers to the prominently curved, somewhat raptorial-like outer paraproct lobe.

**Diagnosis.** As indicated above under *N. clavaloba*, this species shares the enlarged, spine-like structure on the paraprocts. These paraproct lobes are acute and slender in lateral aspect for *N. raptoraloba* and *N. tenuiloba* (described below) but club shaped in *N. clavaloba*. *Nemoura raptoraloba* has a cluster of spines on tergum 10 adjacent to the epiproct which are absent in *N. tenuiloba* and the epiproct is more quadrangular in outline for the latter species.

*Nemoura spinacerca* sp. n.  
(Figs. 17-20)

**Material examined.** Holotype ♂ and 15♂ paratypes from Phu Hin Rongkla National Park, Huai Man Daeng Noi trail, near km 2, 101° 03' N, 16° 47' E, 1600 m, Loei Province, Thailand, 27 March 2002, Chiang Mai University Team, Malaise Trap (PMSL). Additional Paratypes: Thailand: Type locality, 22 April 2002, 33♂ (PMSL). Type locality 22 May 2002, 50♂, 42♀ (PMSL). Type locality, 20 May-21 June 2002, 60♂ (PMSL). Type locality, 20 July-23 August 2002, 12♂, 14♀ (BPS). Type locality, 22-23 August

2002, 4♂ (PMSL). Type locality, 27 August-27 September, 7♂, 58♀ (PMSL). Type locality, 21 September-21 October 2002, 9♂, 31♀ (PMSL). Type locality, 21 October-16 November 2002, 5♂ (PMSL). Type locality, 14 November-14 December 2002, 3♂ (PMSL). Type locality, 17 December 2002-17 January 2003, 4♂ (PMSL). Type locality, 10 January-10 February 2003, 4♂ (PMSL). Type locality, 10 February-17 March 2003, 5♂ (PMSL). Type locality, 17 March- 10 April 2003, 16♂, 8♀ (BPS). Type locality, 5 April-5 May 2003, 33♂ (BPS). Type locality, 5 May-5 June 2003, 31♂ (PMSL).

**Adult habitus.** General color brown. Antennae uniformly brown. Legs uniformly pale brown.

**Male.** Forewing length 7 mm. Tergum 9 with a pair of sparse patches of sensilla basiconica and tergum 10 with a few sensilla basiconica along anterior margin (Fig. 17). Epiproct short, wide, constricted apically and bearing an apical pair of large, sclerotized hooks that curve outward and a pair of short parallel median lobes that are closely appressed. Cerci wide, with a mesoventral spine and an apical finger-like process (Figs. 17-19). Vesicle about twice as long as wide (Fig. 18).

**Female.** Forewing length 9 mm. Sternum 7 produced into wide strongly sclerotized lobe reaching nearly the half of sternite 8 (Fig. 20); apex truncate.

**Larva.** Unknown.

**Etymology.** The species name refers to the prominent ventral cercal spine.

**Diagnosis.** See *N. stylocerca* below. This species is a member of the *Cercispinosa* Complex recognized by Baumann (1975).

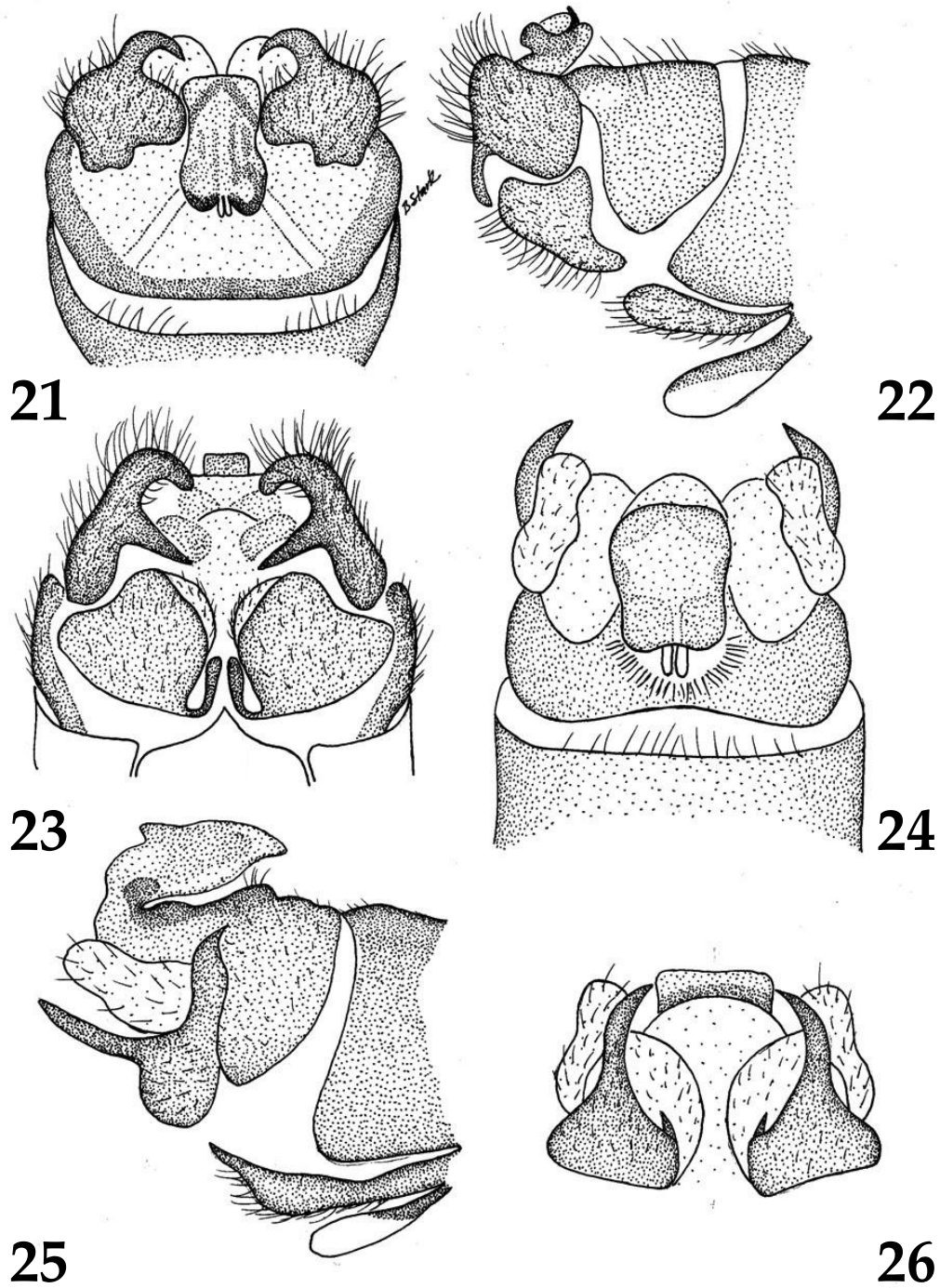
*Nemoura stylocerca* sp. n.  
(Figs. 21-23)

**Material examined.** Holotype ♂ from ca. 12 km along road from Sapa to Lai Chau, Lao Cai Province, Vietnam, 1950 m, 22° 20.583' N, 103° 46.157' E, 1-12 May 1999, B. Hubley, ROM 992002 (ROM).

**Adult habitus.** General color dark brown. Head, pronotum and antennae uniformly dark brown. Femora brown, but darker near knee. Wings dark brown but with a small transparent spot near cord.

**Male.** Forewing length 8 mm. Abdominal terga 1-7 poorly sclerotized, incomplete mesally; terga 8-10 with a complete sclerotized ring. Terga without





Figs. 21-26. *Nemoura* male genitalia. *N. stylocerca* (21-23), 21. Male terminalia, dorsal. 22. Male terminalia, lateral. 23. Male terminalia, ventral. *N. tenuiloba* (24-26), 24. Male terminalia, dorsal. 25. Male terminalia, lateral. 26. Male paraprocts and cerci, ventral.

obvious sensilla basiconica. Epiproct with a dorsal constriction near midlength (Fig. 21); apex notched and bearing a pair of small finger-like processes in the notch and a pair of small, curved horns adjacent to notch and appressed to anterior margin of epiproct (Figs. 21-22); lateral aspect with a prominent raised knob near midlength (Fig. 22). Cerci consisting of a large dorsobasal lobe with apical hook and a smaller, stylus-like ventral lobe (Figs. 21-23). Inner lobe of paraprocts small, club shaped, outer lobe large and somewhat triangular in outline; vesicle typical.

**Female.** Unknown.

**Larva.** Unknown.

**Etymology.** The species name refers to the stylus-like ventral lobe of the cerci.

**Diagnosis.** This species is similar to *N. spinacerca* in cercal and epiproct structure, but the dorsolateral arms on the epiproct are larger in that species and tergum 9 of that species bears a conspicuous patch of sensilla basiconica. This species is a member of the *Cercispinosa* Complex recognized by Baumann (1975).

*Nemoura tenuiloba* sp. n.  
(Figs. 24-26)

**Material examined.** Holotype ♂ from Muong Hoa Ho River, Lao Cai Province, Vietnam, 5-12 May 1995, D. Currie, B. Hubley, J. Swann, ROM 956007 (ROM).

**Adult habitus.** (Teneral specimen). Body color pale brown, wings milky, not fully pigmented. Legs, head and pronotum pale brown.

**Male.** Forewing length 5 mm. Abdominal tergum 9 poorly sclerotized and without sensilla basiconica, but bearing a row of fine hairs along posterior margin (Fig. 24); tergum 10 bearing a semicircular group of hairs near epiproct apex (Fig. 24), and strongly sclerotized beneath epiproct (Fig. 25). Epiproct poorly sclerotized and somewhat quadrangular in dorsal aspect but with a pair of short projecting apical processes; lateral aspect with a posteriorly directed dorsal lobe at midlength (Fig. 25). Paraprocts broad basally and strongly narrowed to a thin, acute lobe; inner angles of paraprocts bearing a thin spike-like structure, present on right side but apparently broken on left and added to Figure 26.

**Female.** Unknown.

**Larva.** Unknown.

**Etymology.** The species name refers to the thin paraproct lobe.

**Diagnosis.** This species is similar to *N. clavaloba* and *N. raptoraloba* in paraproct structure but the absence of tergal spines on segment 10 distinguishes it from the latter species and the absence of serrae on the epiproct distinguishes it from the former.

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