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## The Caddisfly Family Lepidostomatidae (Trichoptera) in Vietnam<sup>1</sup>

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**Abstract:** The Vietnamese Lepidostomatidae (Trichoptera) includes three genera (*Zephyropsyche*, *Paraphlegopteryx*, and *Lepidostoma*) and 28 species. Of the 24 species of *Lepidostoma*, 12 of which are first described in this paper, 17 belong to the *Lepidostoma ferox* branch and seven belong to the *Lepidostoma hirtum* branch. New species described herein include *Lepidostoma hansmalickyi*, *L. wolframii*, *L. fansipanense*, *L. laocai*, *L. teuthis*, *L. cataracta*, *L. crepusculum*, *L. moschoceros*, *L. incomptum*, *L. bamboo*, *L. dipterocarpium*, and *L. hinnuleus*. Finally, *Lepidostoma navasi* WEAVER 2002 was determined to be a junior synonym of *L. timbaka* (MOSELY 1949b).

**Key words:** Trichoptera, Lepidostomatidae, *Lepidostoma*, caddisfly, Vietnam, new species.

### Introduction

The caddisfly family Lepidostomatidae is represented by seven extant and three fossil genera. It is a widespread and diverse family, occurring in the Nearctic, Palaearctic, Oriental, and Afrotropical Regions, and northern areas of the Neotropical and Australian Regions. The family is characterized by sexual dimorphism with the adult males exhibiting a wide variety of secondary sexual characters. This is especially true in the genus *Lepidostoma* in which there are diverse modifications of the antennal scapes, maxillary palps, wings, and forelegs.

The caddisfly fauna of Vietnam has received increased attention in the last two decades. The vast majority of the approximately 400 species known from Vietnam are endemic (ARMITAGE et al. 2005, ARMITAGE & AREFINA-ARMITAGE 2009, MEY 2005). The family Lepidostomatidae in Vietnam has representatives from both subfamilies (WEAVER 1993, 1999, 2002): the Lepidostomatinae (*Lepidostoma* and *Paraphlegopteryx*) and the Thelicopsychinae (*Zephyropsyche*). Sixteen species in these genera were previously known from Vietnam, twelve new species in the genus *Lepidostoma* are described herein, and one new synonymy is proposed. Twenty of the 28 species of Lepidostomatidae from Vietnam are currently endemic to that country. All species of *Lepidostoma* now known from Vietnam (Tab. 1) are members of either the *L. ferox* branch [17 species] or the *L. hirtum* branch [7 species].

The new species described in this paper were based on specimens collected or provided by Dr. Wolfram Mey of the Museum für Naturkunde der Humboldt-Universität zu Berlin (MNHB), and by personnel of the Royal Ontario Museum (ROM; 1995-2000) and the American Museum of Natural History (AMNH; 1998-1999). The latter two museums conducted surveys on multiple faunal groups in Vietnam to gather information about the biodiversity of that

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<sup>1</sup> This paper is dedicated to Prof. Dr. Hans Malicky on the occasion of his 75<sup>th</sup> birthday.

country. This information will provide baseline data to evaluate changes with time, and formulate resource management strategies.

Terminology follows that of WEAVER (1988). Type specimens are deposited in the following museums as differentiated in the species accounts: American Museum of Natural History, New York, U.S.A. (AMNH); Museum für Naturkunde der Humboldt-Universität zu Berlin, Germany (MNHB); Muséum National d'Histoire Naturelle, Paris, France (MNHN); Naturhistoriska Riksmuseet, Stockholm, Sweden (NHRM); and, Royal Ontario Museum, Toronto, Canada (ROM).

## Results

### *Lepidostoma hansmalickyi* nov.sp. (Figs 1-8)

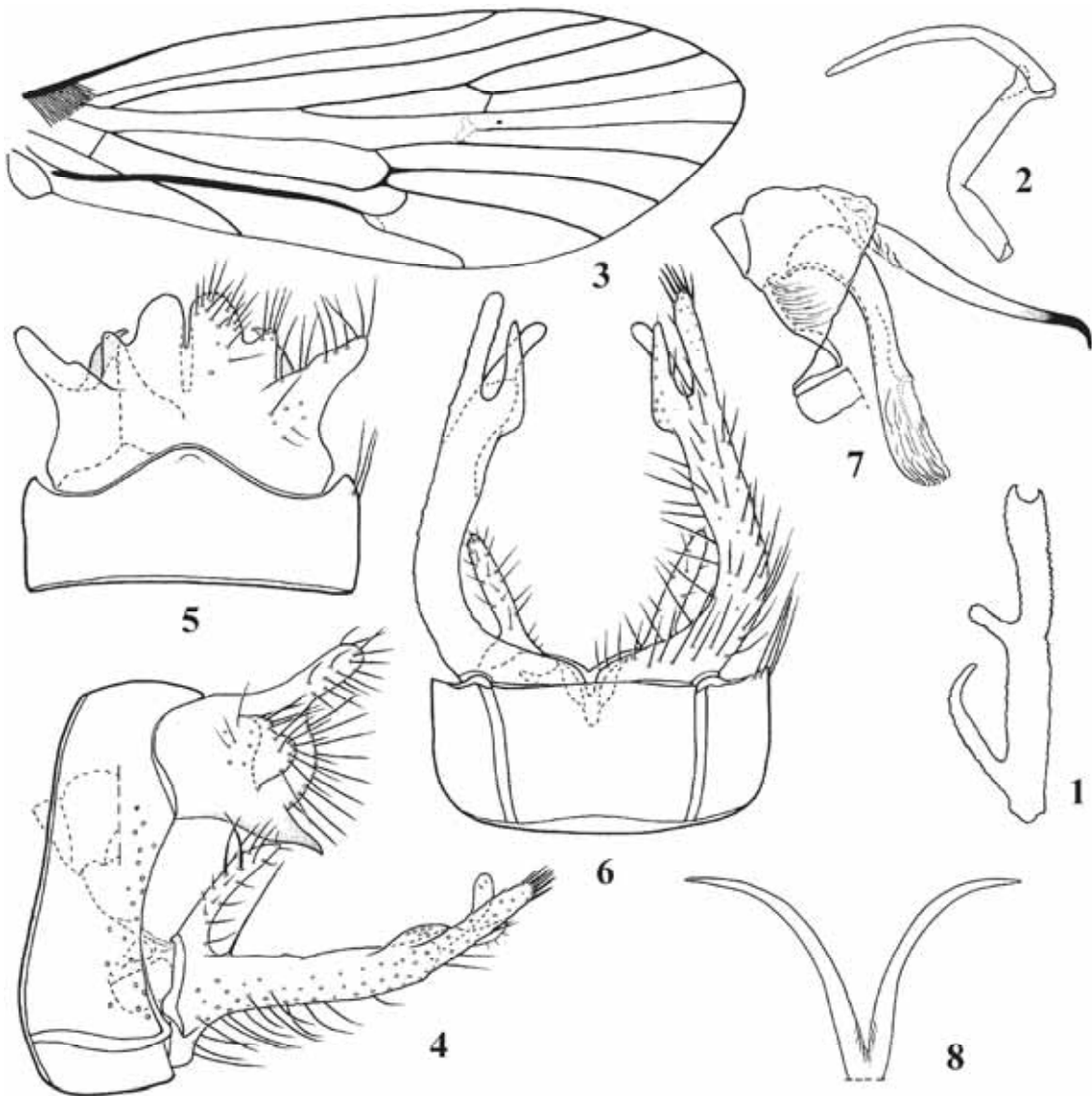
**H o l o t y p e :** ♂ in EtOH [ROM 956022]: Lao Cai, Sa Pa, large waterfall on road from Sa Pa to Lai Chau, UV light, 8.V.1995, D. Currie, B. Hubley & J. Swann. **P a r a t y p e s :** 1♂, 2♀♀ in EtOH [ROM 956022]: same data as holotype; 3♂♂, 4♀♀ pinned & 2♂♂, 1♀ in EtOH [MNHB]: Fan Si Pan, Sa Pa, 25-30.III.1995, W. Mey; 8♂♂, 5♀♀ in EtOH [MNHB]: Fan Si Pan, Sa Pa, 20-30.X.1995, W. Mey; 1♂ pinned [MNHB]: Fan Si Pan, Sa Pa, 1520 m, 20.17N 103.45E, 01-05.III.1995, R. Brechlin.

**D i a g n o s i s .** This species is included in the *Lepidostoma ferox* branch; it is similar to *L. esban* MALICKY 2008, but differs by having male scape with an additional dorsomesal process, inferior appendage with basodorsal process longer, and phallus with parameres longer.

**D e s c r i p t i o n .** Male. Color brown. Head (Figs 1, 2), vertex blunt; antennal warts absent; occipital warts rounded triangular; frons mostly glabrous and concave, ventral portion with ridge along meson above clypeus, postorbital warts slender and elongate. Scapes each 2.0 mm, having basodorsal process 0.6 mm long and slender; and dorsomesal process at mid length 0.2-0.3 mm long, stout and bearing several thick setae. Maxillary palps each 2.5 mm; first segment 1.2 mm, arm-like, curved dorsoanteriorly, bearing mixture of long slender setae and scales ventrally and apicoventral tuft of long, slender setae (almost as long as apical segment); second segment 1.3 mm, slender and flexible. Forewings (Fig. 3) each 8.0 mm long and 3.1 mm wide, with basal pocket bearing pile of thick setae; anal groove equal to length of stem of *M*. Hind wings each 6.2 mm long and 2.4 mm wide. Mesonotum: scutal warts bulbous, adjacent to each other and together chordate; scutellar warts small, circular and well separated.

**Genitalia** (Figs 4-8). Segment IX cylindrical, dorsal margin with curved incisions laterally and middle portion of dorsum rounded and projecting posterad. Segment X symmetrical with dorsomesal processes each short, lobiform, twice as long as wide, protecting dorsoposterad in lateral view; intermediate lateral processes each triangular in dorsal view, irregular lobiform in lateral view; ventrolateral processes each sharply pointed, directed ventroposterad, almost twice as long as basal width, slightly longer than dorsomesal processes in lateral view (concealed by other processes and not conspicuous in dorsal view). Inferior appendages each with first article (or main article) long and slender; having 1) basodorsal process with length 0.6X as long as main article, basal 2/5 directed dorsad, apical 3/5 tapered and slanted posterad; 2) apicodorsal process lobiform, setose, directed posterad, base angled mesad and apical portion directed dorsoposterad; 3) apicoventral process lobiform, directed posterad; and 4) basoventral process absent; and 5) second article in apicodorsal position, thumblike, articulated and bending mesad in lateral view. Parameres symmetrical, slender, length 1.2X as long as phallicata, gradually curved laterad with apices curved posteroventrad.

**Etymology.** This species is named after Hans Malicky in honor of his lifetime contribution to the scientific knowledge of Trichoptera.



**Figs 1-8:** *Lepidostoma hansmalickyi* nov.sp., ♂; (1) right scape, dorsal; (2) left maxillary palp, lateral; (3) right forewing; (4-8) genitalia: (4) lateral; (5) dorsal; (6) ventral; (7) phallus, lateral; (8) parameres, dorsal.

***Lepidostoma wolframi* nov.sp. (Figs 9-15)**

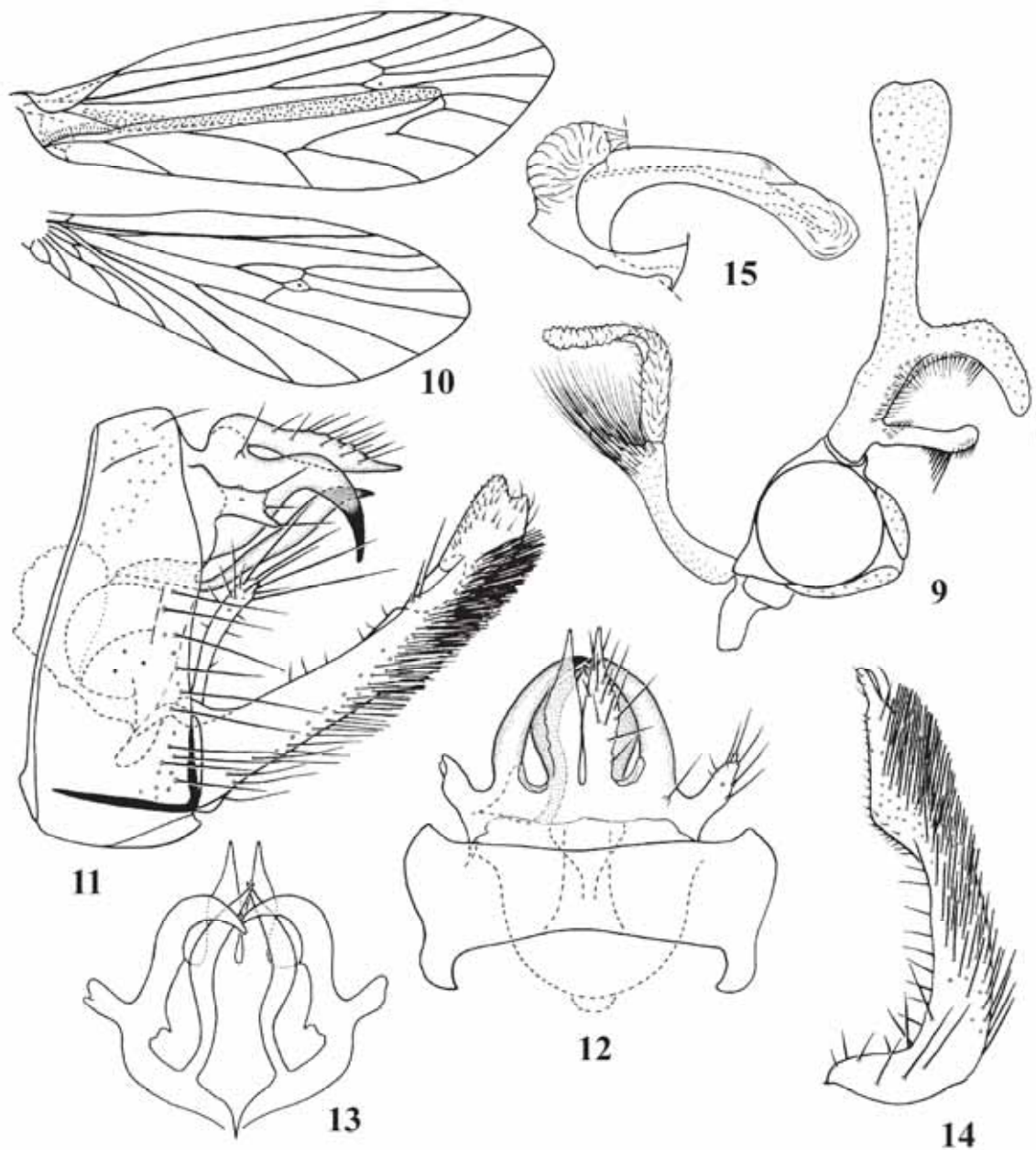
**H o l o t y p e :** ♂ pinned [MNHB]; Fan Si Pan, Sa Pa, 25-30.III.1995, W. Mey.

**D i a g n o s i s .** This species is included in the *Lepidostoma ferox* branch; it is similar to *Lepidostoma horridum* (SCHMID 1959), but differs by having segment X with intermediate lateral process shaped like a cat's claw; ventromesal process having ventral margin smoothly curved without intermediate ventral teeth; and, inferior appendage with basodorsal process directed dorsad, only inclined slightly posterad.

**D e s c r i p t i o n .** Male. Color brown. Head (Fig. 9), vertex blunt; antennal warts absent; occipital warts rounded triangular; frons mostly glabrous and concave. Scapes each 1.6 mm, bearing two basodorsal processes, first process 0.44 mm, with apex curved anterad and second process 0.55 mm, with apical half curved posterad; basomesal surface between processes concave and striated. Maxillary palps each 1.15 mm; first segment 0.8 mm and second segment 0.5 mm. Wings (Fig. 10); forewings each 10.5 mm long, 3.4 mm wide, slender with basal pocket and anal pocket bearing long setae, anal groove extended distad well beyond discoidal cell, bearing many short scales and distorting median and cubital veins. Hind wings each 8.4 mm long, 3.3 mm wide. Mesonotum: scutal warts large and elliptical, separated; scutellar warts small and elliptical.

**Genitalia** (Figs 11-15). Segment IX cylindrical, ringlike, tapering dorsally in lateral view. Segment X with four pairs of processes: 1) dorsomesal processes each lanceolate with apex directed posterad and sharply pointed; 2) intermediate lateral processes each slightly asymmetrical, each curved strongly with apex directed ventrad and sharply pointed; 3) ventromesal processes each sinuate, with apex directed posterad, adjacent to that of dorsomesal process and sharply pointed; and 4) lateral processes directed posterad and inclined slightly ventrad, irregular trapezoidal, each with minute ventroposterior process in lateral view. Inferior appendages shaped like a nutcracker in ventral view; each with first article long, rodlike, uniform in height and apex bilobed with shallow mesal notch in lateral view; having 1) basodorsal process slender, clavate, directed dorsad and inclined slightly posterad, almost half as long as main article; 2) apicodorsal, apicoventral and basoventral processes absent; and 3) second article contiguous with main article, 1/4 as long as main article, having apical margin weakly bilobed in lateral view. Phallicata curved ventroposterad; parameres absent.

**E t y m o l o g y .** This species is named after Wolfram Mey in honor of his contributions to Trichoptera and for making his collections of lepidostomatids available for us to examine and include in this work.



**Figs 9-15:** *Lepidostoma wolframi* nov.sp., ♂; (9) head, lateral; (10) right wings; (11-15) genitalia: (11) lateral; (12) dorsal; (13) segment X, ventral; (14) left inferior appendage, ventral; (15) phallus, lateral.



***Lepidostoma fansipanense* nov.sp. (Figs 16-23)**

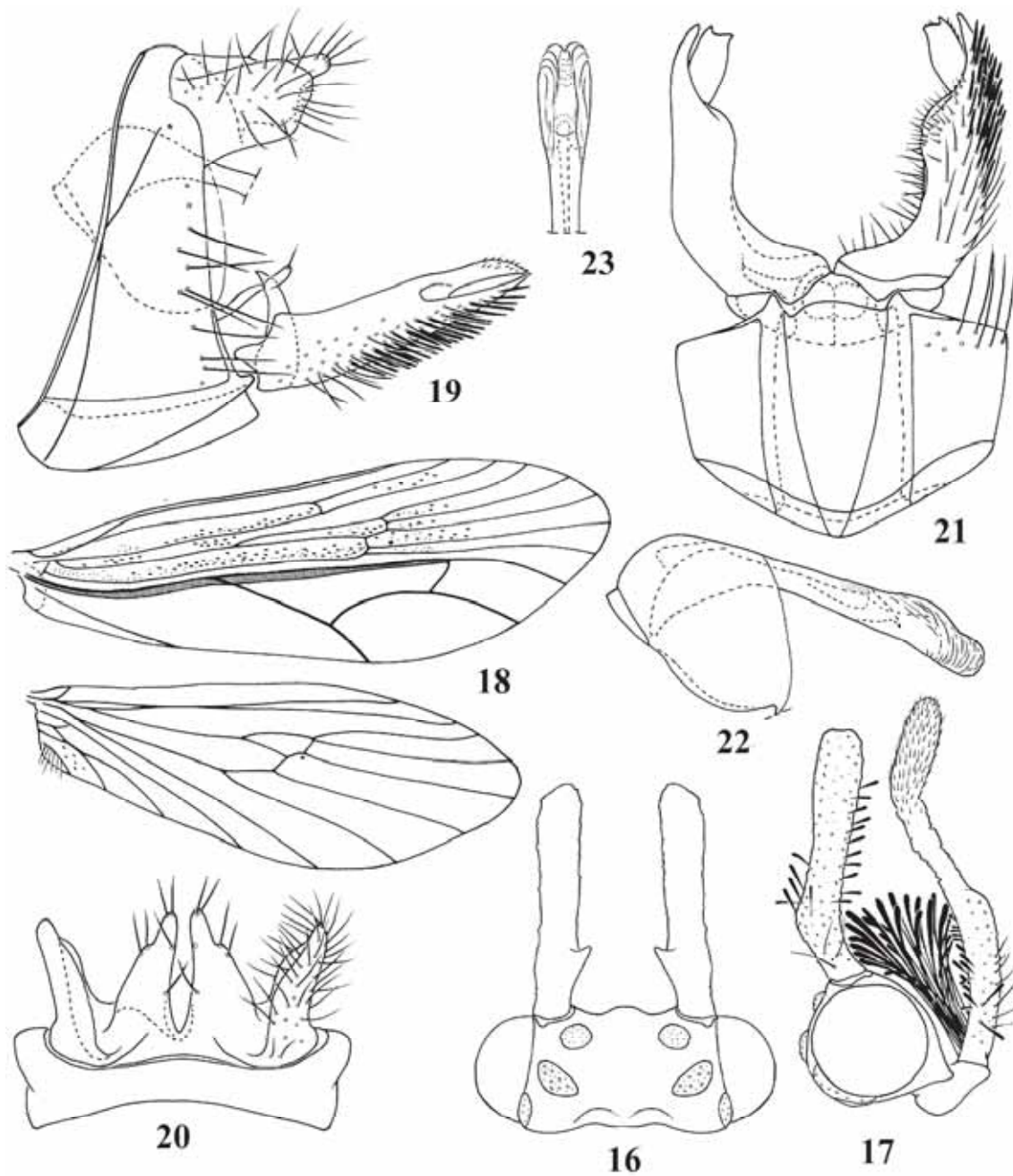
**H o l o t y p e :** ♂ pinned [MNHB]: Fan Si Pan, Sa Pa, 25-30.III.1995, W. Mey. **P a r a t y p e s :** 1 ♀ in EtOH [MNHB]: same data as holotype; 4 ♂ ♂, 2 ♀ ♀ in EtOH (1 ♂, 1 ♀) [MNHB]: Fan Si Pan, Sa Pa, 1-7.XI.1995, W. Mey.

**D i a g n o s i s .** This species is included in the *Lepidostoma ferox* branch; it is similar to *L. digitatum* (MOSELY 1949b), but differs by having male scape bearing a simple toothlike basomesal process, segment X with dorsomesal and lateral processes shorter and broader basally in dorsal view, and inferior appendage with apicoventral process present. This species is also similar to *Lepidostoma laocai* nov.sp., but differs by having male scape with basomesal process smaller and apical process of inferior appendage longer.

**D e s c r i p t i o n .** Male. Color brown. Head (Figs 16, 17), vertex short broad semicircular, almost elliptical; antennal warts small and elliptical; occipital warts about twice as large as antennal warts; frons mostly glabrous. Scapes each 1.0 mm, almost cylindrical, except bent at base and bearing minute basomesal tooth. Maxillary palps each 1.5 mm; first segment 1.1 mm, bearing dense tuft of long capitate scales basally; second segment 0.5 mm, ovate and covered with short fine setae. Wings (Fig. 18); forewings each 9.7 mm long, 3.2 mm wide, basal pocket extended into long slender fold along anterior margin, bearing slender scales; anterior region bearing minute scales and short setae; middle of  $R_1$ ,  $R_{2+3}$  and  $R_{4+5}$  densely covered with short fine setae; anal groove slender, extended distad as far as apex of  $Sc$  and bearing slender scales along anterior margin. Hind wings each 8.0 mm long, 3.0 mm wide. Mesonotum: scutal warts elliptical; scutellar warts small and elliptical.

**Genitalia** (Figs 19-23). Segment IX wedge-shaped, venter having length 3X as long as dorsum in lateral view. Segment X symmetrical, with dorsomesal processes each triangular and having length 2X basal width in dorsal view; and ventrolateral processes each flat, rounded trapezoidal, length 1.5X as long as basal width in lateral view. Inferior appendages each with first article long, rectangular; having 1) basodorsal process slender, lobiform, sitting on elevated basomesal portion of main article; 2) second article in apicodorsal position, slender, length 3X as long as main article, apex with two points separated by shallow mesal notch; 3) apicoventral process length subequal to second article, tapered apically, directed posterad; and 4) basoventral process absent. Phallicata nearly straight, directed ventroposterad; parameres absent.

**E t y m o l o g y .** This species is named after Fan Si Pan, the highest mountain in Vietnam.



**Figs 16-23:** *Lepidostoma fansipanense* nov.sp., ♂; (16) head, dorsal; (17) head, lateral; (18) right wings; (19-23) genitalia: (19) lateral; (20) dorsal; (21) ventral; (22) phallus, lateral; (23) distal end of phallus, dorsal.

***Lepidostoma laocai* nov.sp. (Figs 24-30)**

**H o l o t y p e :** ♂ in EtOH [ROM956024]: Lao Cai, Sa Pa, along road from Quy Hô to Ta Giang Phinh, 9.V.1995, D. Currie, B. Hubley & J. Swann. **P a r a t y p e :** 1♂ in EtOH, same data as holotype.

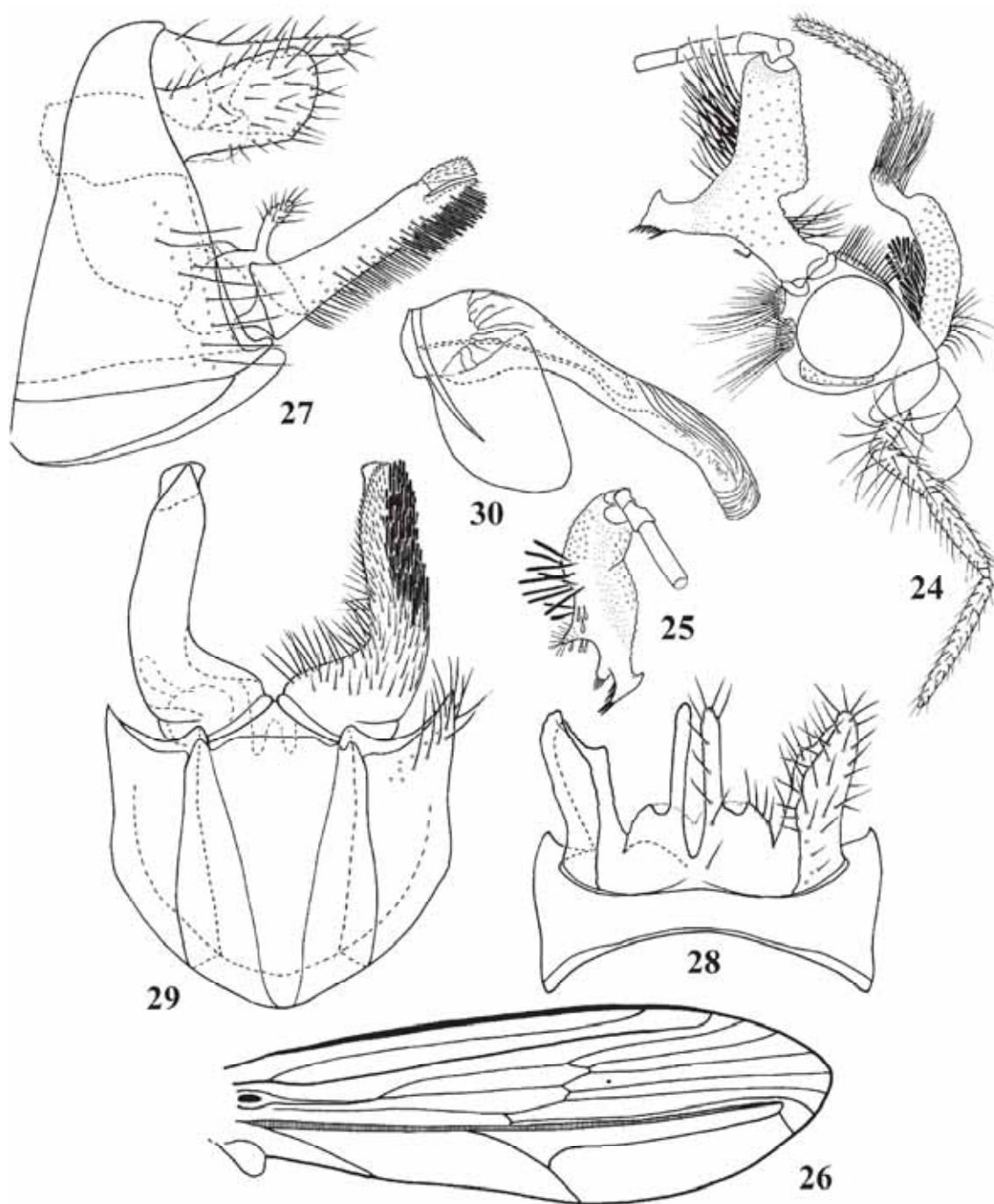
**D i a g n o s i s .** This species is included in the *Lepidostoma ferox* branch; it is very similar to *L. digitatum* (MOSELY 1949b), but differs by having male segment X with lateral process rounded apically in lateral view, and inferior appendage with apicoventral process present. This species is also similar to *L. fansipanense* nov.sp., but differs by having male scape with basomesal process larger and more complex.

**D e s c r i p t i o n .** Male. Color brown. Head (Fig. 24) held high with bases of antennae directed dorsad; vertex with short, whitish frontal knob having a pair of tiny round basal warts, antennal warts large, almost round, occipital warts nearly elliptical, almost equal in size to antennal warts; frons flat with large, round anterolateral warts, each comprising almost entire area from lateral margin to meson. Scares (Fig. 25) each 1.2 mm, stout, geniculate, distal 2/3 angled anterad and bearing many long slender scales along dorsoposterior margin; basodorsal process directed posteromesad, complex, having 1) apex anchor-like, bearing two divaricating points, 2) subapical posterior margin bearing row of short spine-like setae, 3) small subapicomesal nipple bearing short bundle of thick setae, and 4) basomesal triangular projection. Maxillary palps each 2.0 mm, weakly sclerotized, first segment 1.0 mm, whitish, with subapical constriction, bearing rather long and slender brownish scales apically, second segment 1.0 mm, whitish, flexible, covered with short golden setae. Forewings (Fig. 26) each 10.2 mm long, 3.2 mm wide, basal pocket with tuft of long slender scales and extended into long slender postcostal fold bearing thin scales, lengths of which gradually decreases apically; anal groove very long, extended beyond apex  $R_3$  and bearing row with combination of long slender and short thick scales along its anterior margin. Hind wings each 8.2 mm long, 3.0 mm wide. Mesonotal warts bearing long setae, scutal warts large elliptical and adjacent to each other; scutellar warts elliptical and half as long as scutal warts.

**Genitalia** (Figs 27-30). Segment IX slender, ringlike, length of dorsum 0.3 X that of venter in lateral view. Segment X symmetrical; dorsomesal processes each with base wide and distal 2/3 slender and fingerlike; ventrolateral processes each platelike, broad, rounded rectangular, length 2X basal height in lateral view. Inferior appendages each with first article long, slender rectangular, length 4X basal height in lateral view, mesal margin smoothly curved in ventral view; having 1) basodorsal process short, slender, lobiform, length 1/4 as long as main article, with apex curved posterad; 2) second article in apicodorsal position, rectangular, dorsal margin aligned with that of main article, length 2.5X basal height in lateral view; 3) apicoventral process length subequal to second article, basal height subequal to second article, acuminate in lateral view; and 4) ventromesal process absent. Phallicata inclined ventroposterad, parameres absent.

**E t y m o l o g y .** This species is named after Lao Cai Province in northern Vietnam, from which this species was collected.





**Figs 24-30:** *Lepidostoma laocai* nov.sp., ♂; (24) head, lateral; (25) right scape, dorsomesal; (26) right forewing; (27-30) genitalia: (27) lateral; (28) dorsal; (29) ventral; (30) phallus, lateral.

***Lepidostoma teuthis* nov.sp. (Figs 31-37)**

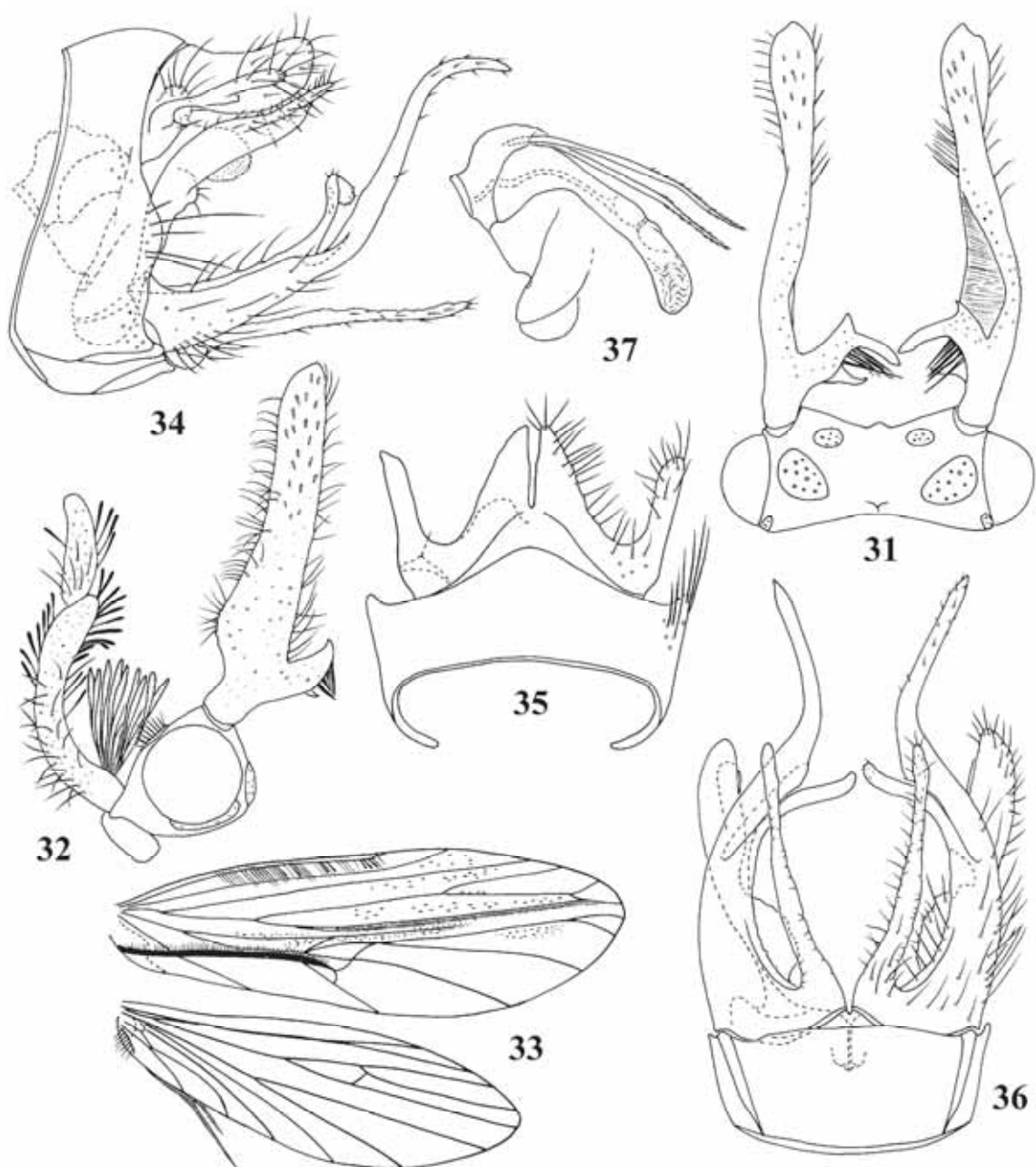
**H o l o t y p e :** ♂ pinned [MNHB]: Fan Si Pan, Sa Pa, 1-7.XI.1995, W. Mey. **P a r a t y p e s :** 3♂♂, 1♀ in EtOH [MNHB]: same data as holotype.

**D i a g n o s i s .** This species is included in the *Lepidostoma ferox* branch; it is similar to *L. kimminsi* WEAVER 2002, but differs by having male scape with basomesal process present and inferior appendage with the basodorsal process larger.

**D e s c r i p t i o n .** Male. Color brown. Head (Figs 31, 32) vertex blunt, antennal warts rounded triangular; occipital warts rounded triangular; frons with anterolateral warts large and bearing slender lanceolate scales. Scares each 1.9 mm, basodorsal process with three irregular processes, short basal lobe directed mesad, long blade-like processes directed mesad, and apical short triangular process directed anterad, basal half with mesal surface concave and striated. Maxillary palps each 1.4 mm, bearing mixture of scales and setae; first segment 0.9 mm, with basomesal tuft of long petiolate scales; second segment 0.5 mm. Wings (Fig. 33); forewings each 9.5 mm long and 3.1 mm wide; basal half of anterior margin with slender postcostal cell bearing long slender scales; anterior region bearing combination of short setae and scales; median groove running full length of wing, bearing short fine setae, with row of short scale along its posterior margin; anal groove 2/5 length of wing. Hind wings each 7.8 mm long, 2.6 mm wide. Mesonotum: scutal warts indistinct; scutellar warts small and circular.

**Genitalia** (Figs 34-37). Segment IX having length uniform except posterior margin of dorsal half concave in lateral view. Segment X symmetrical with dorsomesal processes each triangular and separated by narrow mesal notch, length about 2X basal width; ventrolateral processes each nearly straight with lateral and mesal margins nearly straight and parallel, length 3X basal width, apex tapered and directed posterad and bent laterad slightly in dorsal view. Inferior appendages each with main article rectangular and tapered slightly posterad; having 1) basodorsal process long, extended to apicovental margin of segment X, irregular; basal half extended dorsad, bent slightly posterad and widening distally; apical half curved and directed dorsoposterad and bifid; 2) second article (in apicodorsal position) curved mesad, less than half as long as ventromesal process; 3) apicolateral process long, slender, sinuate, vermiform, length 1.8X as long as main article, apex pointed, directed dorsoposterad with apical 1/4 curved ventroposterad; 4) ventromesal process long, slender, irregular, vermiform, extended ventroposterad, length 1.8X as long as main article. Phallicata symmetrical curved ventrad; parameres slender, nearly straight, length 0.8X as long as phallicata.

**E t y m o l o g y .** Greek: *teuthis*, squid (noun); named after exceptionally long tentacle-like processes of the inferior appendages.



**Figs 31-37:** *Lepidostoma teuthis* nov.sp., ♂; (31) head, dorsal; (32) head, lateral; (33) right wings; (34-37) genitalia: (34) lateral; (35) dorsal; (36) ventral; (37) phallus, lateral.

***Lepidostoma cataracta* nov.sp. (Figs 38-44)**

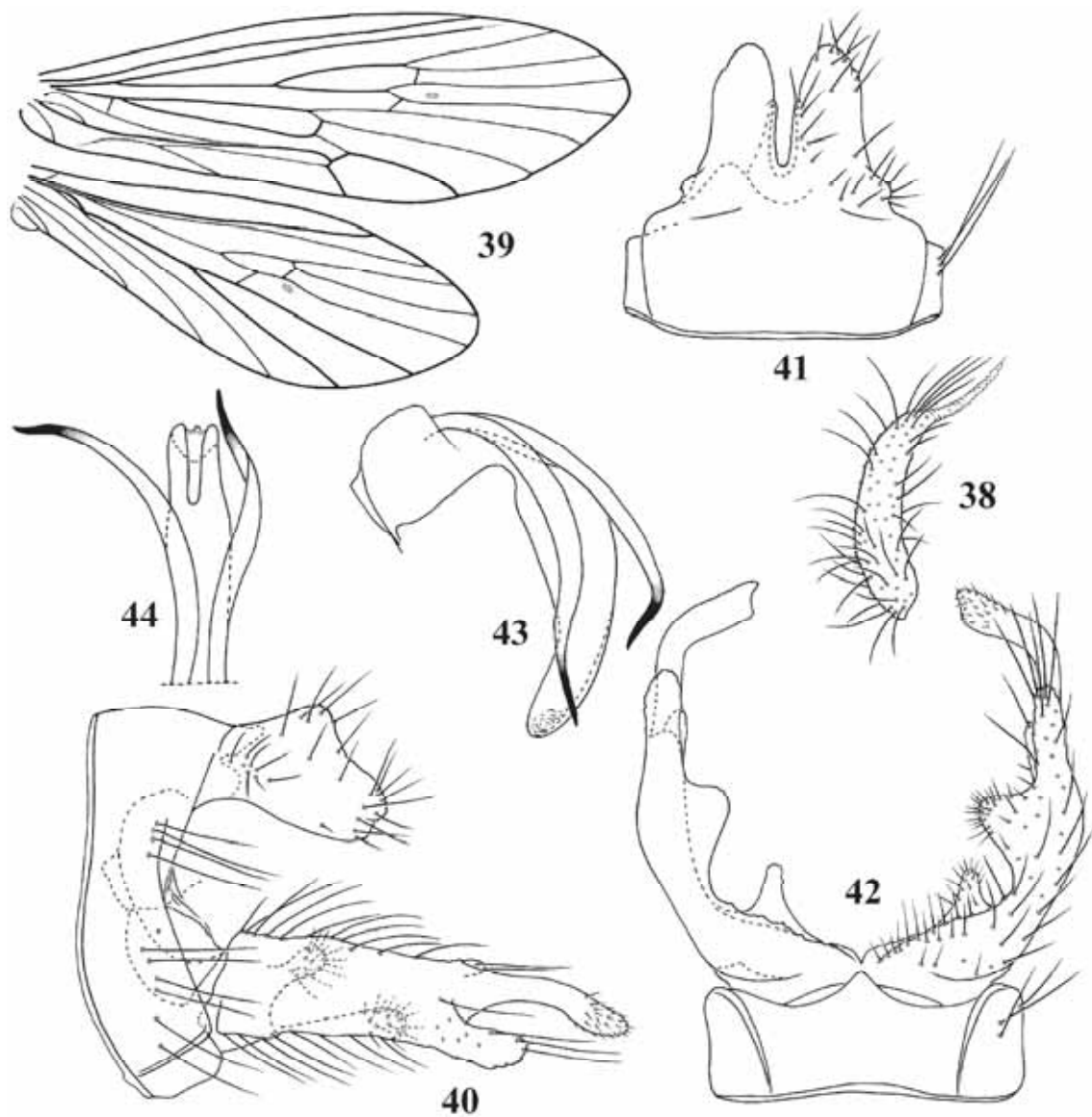
**H o l o t y p e :** ♂ in EtOH [ROM 956022]: Lao Cai, Sa Pa, large waterfall on road from Sa Pa to Lai Chau, UV light, 08.V.1995, D. Currie, B. Hubley & J. Swann. **P a r a t y p e :** 1 ♂ in EtOH [MNHB]: Fan Si Pan, Sa Pa, 20-30.X.1995, W. Mey. **O t h e r m a t e r i a l :** 2 ♀ ♀ in EtOH [MNHB]: same data as paratype.

**D i a g n o s i s .** This species is included in the *Lepidostoma ferox* branch; it is remotely similar to *L. lannaense* (MALICKY & CHANTARAMONGKOL 1994), but differs by having male segment X dorsomesal process rounded apically in dorsal view and with a dorsal hump in lateral view, and parameres sinuate.

**D e s c r i p t i o n .** Male. Color brown. Head vertex blunt, antennal warts each nearly circular, occipital warts rounded triangular; frons mostly glabrous, anterolateral warts small, elliptical, with height less than half eye. Scapes each 0.85 mm, simple and cylindrical. Maxillary palps (Fig. 38) each with first segment 0.30 mm and second segment expanding from 0.03 to 0.23 mm. Wings (Fig. 39); forewings each 7.3 mm long and 2.5 mm wide, venation only slightly modified, without basal pocket, anal groove slender, extended distad slightly beyond thyridial cell, causing very little modification in typical venation, arculus in distal position adjacent to fork 5. Hind wings each 5.9 mm long, 2.3 mm wide. Mesonotum: scutal warts nearly circular; scutellar warts broad elliptical, slightly larger than scutal warts.

Genitalia (Figs 40-44). Segment IX slender, ringlike, length of dorsum 1.4X venter in lateral view. Segment X symmetrical with dorsomesal processes each lobiform, length 1.5X as long as basal width and extended posterad in dorsal view; irregular with dorsal hump, ventral margin straight and inclined slightly ventrad, with blunt apex in lateral view; ventrolateral processes absent. Inferior appendages each with first article long and rectangular in lateral view, mesal margin with rounded triangular flange in ventral view; having 1) basodorsal process absent; 2) apicodorsal process minute, lobiform; 3) second article longer than other processes of main article, length 0.4X as long as main article, basal half directed posterad and apical half curved mesad, apex with shallow mesal notch; 4) apicoventral process lobiform, length half as long as second article; and 5) ventromesal process length half as long as apicoventral process and lobiform. Phallicata curved ventrad, parameres asymmetrical; left paramere sinuate with apex directed posterad, right paramere curved to right with apex directed ventroposterad.

**E t y m o l o g y .** Latin: *cataracta*, waterfall (noun); named after the habitat from which the species was collected.



**Figs 38-44:** *Lepidostoma cataracta* nov.sp., ♂; (38) left maxillary palp, lateral; (39) right wings; (40-44) genitalia: (40) lateral; (41) dorsal; (42) ventral; (43) phallus, lateral; (44) distal end of phallus and parameres, dorsal.



***Lepidostoma crepusculum* nov.sp. (Figs 45-52)**

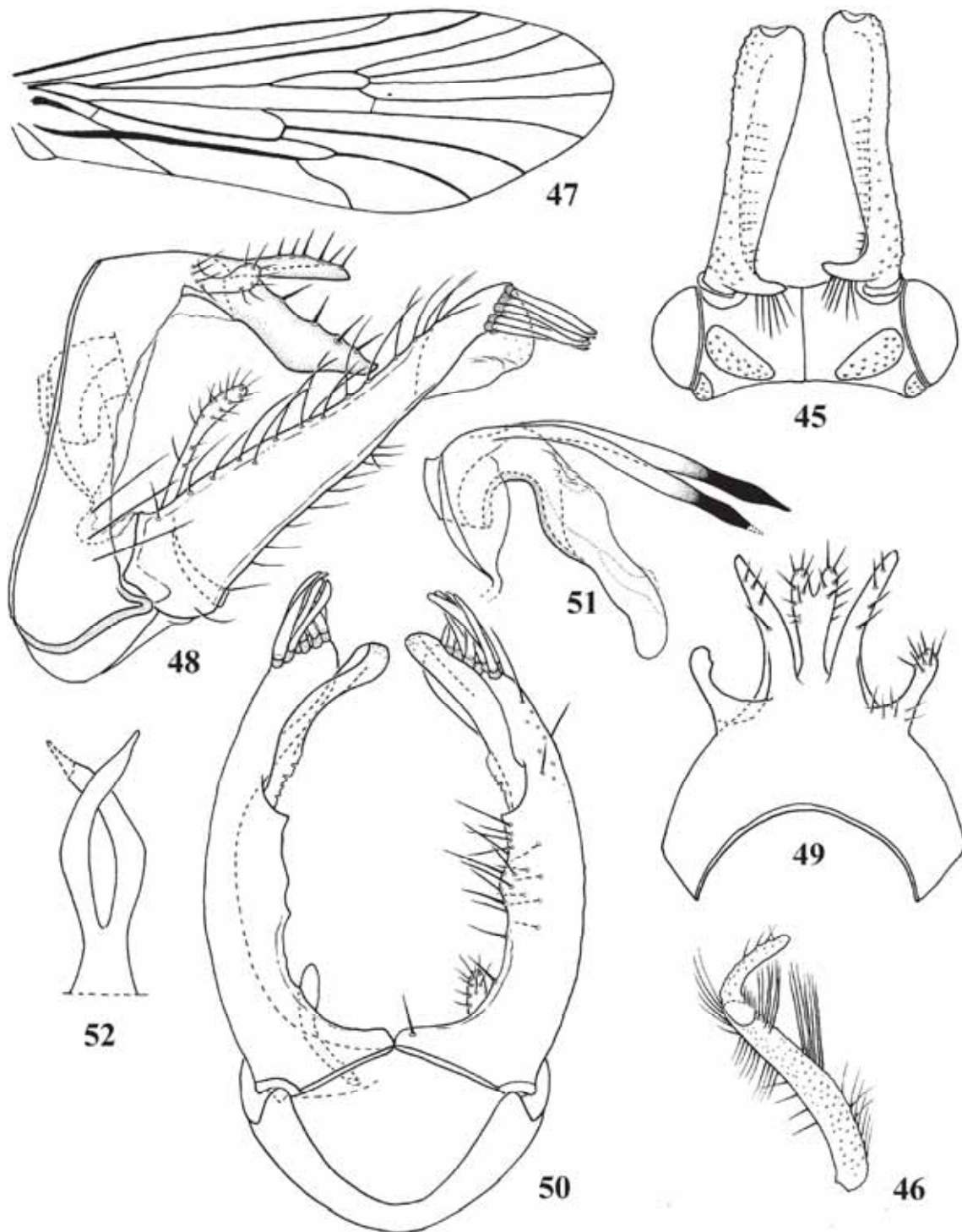
**H o l o t y p e :** ♂ in EtOH [AMNH]: Quang Nam: Ngoc Linh, 1470 m, light trap, 15.00N, 108.04E, 23-27.III.1999, D. Grimaldi, L. Herman, C. Johnson, K. Long & E. Sterling.

**D i a g n o s i s .** This species is included in the *Lepidostoma ferox* branch; it is remotely similar to *L. ramosum* (MOSELY 1949b) but differs by having male scape with the basomesal process toothlike, segment X with a dorsomesal process and a pair of ventromesal and lateral processes present, and the inferior appendage having apex of the main article bearing a conspicuous row of thick setae.

**D e s c r i p t i o n .** Male. Color light brown. Head (Fig. 45), vertex blunt, antennal warts absent, occipital warts rounded triangular; frons mostly glabrous and flat with dorsolateral warts each small, rounded triangular, adjacent to base of antenna. Scapes each 1.1 mm, having canine toothlike basomesal process 0.2 mm long, directed mesad, basal 2/3 with mesal surface concave and striated. Maxillary palps (Fig. 46) each 1.4 mm, first segment 0.9 mm, nearly straight in lateral view, sinuate in ventral view, second segment 0.5 mm, flexible and curved ventrad. Forewings (Fig. 47) each 6.8 mm long and 2.2 mm wide, without basal pocket, anal groove extended slightly beyond thyridial cell. Hind wings each 5.0 mm long, 1.7 mm wide. Mesonotum: scutal warts each elliptical with posteromesal and anterolateral margins acute; scutellar warts each D-shaped with mesal margin nearly straight and lateral margin semicircular.

Genitalia (Figs 48-52). Segment IX somewhat slender with posterior margin slightly concave in lateral view. Segment X symmetrical, dorsomesal process slender, nearly straight and extended posterad with apex bilobed; lateral processes each capitate, extended posterad and half as long as dorsomesal process; ventromesal processes each with dorsal margin nearly straight and inclined posterad, ventral margin with obtuse subapical angle, length 1.3X as long as dorsomesal process in lateral view. Inferior appendages each with first article slender and long, gradually tapered distally, apex bearing row of thick setae; having 1) basodorsal process slender, fingerlike, strongly inclined posterad, length 0.3X as long as main article; 2) second article with base attached to subapex of first article, broad lobiform in lateral view, slender, irregular finger-like in ventral view; and 3) ventromesal process absent. Phallicata with base strongly curved ventrad; parameres nearly symmetrical, curved, crossing each other with apices pointing in opposing directions in dorsal view.

**E t y m o l o g y .** Latin: *crepusculum*, twilight (noun); named for being active at dusk.



**Figs 45-52:** *Lepidostoma crepusculum* nov.sp., ♂; (45) head, dorsal; (46) right maxillary palp, lateral; (47) right forewing; (48-52) genitalia: (48) lateral; (49) dorsal; (50) ventral; (51) phallus, lateral; (52) parameres, dorsal.

***Lepidostoma moschoceros* nov.sp. (Figs 53-58)**

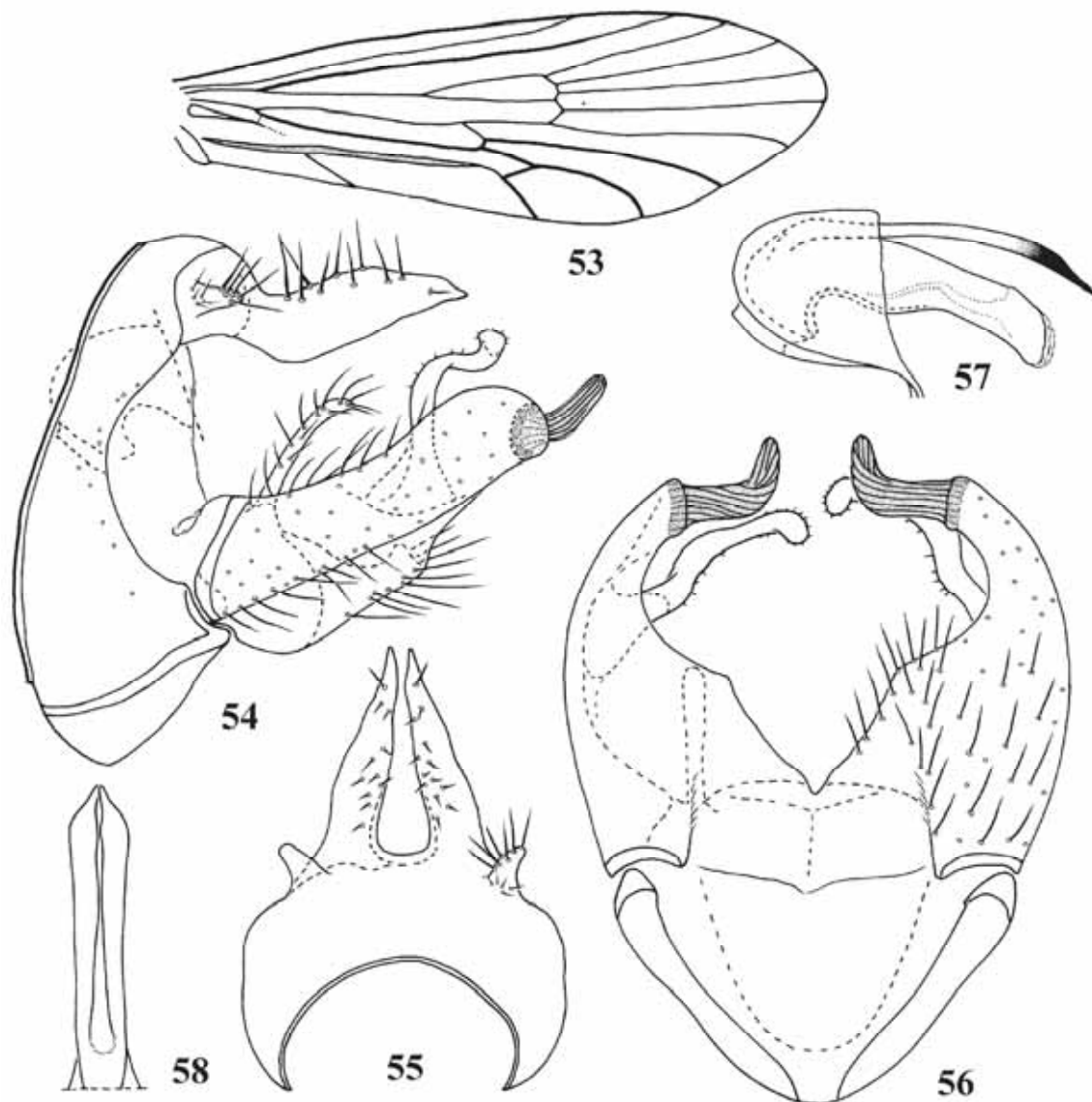
**H o l o t y p e :** ♂ in EtOH [AMNH]: Quang Nam, Ngoc Linh, 920 m, light trap, 15.19N, 108.04E, 15.III.1999, D. Grimaldi, L. Herman, C. Johnson, K. Long & E. Sterling.

**D i a g n o s i s .** This species is included in the *Lepidostoma ferox* branch; it is similar to *L. volutum* (MOSELY 1949a), but differs by having male segment X with dorsomesal process longer and the inferior appendage with main article bearing an apical horn comprising several thick setae fused together and forming a conspicuous process shaped like a cow horn.

**D e s c r i p t i o n .** Male. Color light brown. Head vertex slightly convex, antennal warts absent, occipital warts rounded triangular; frons glabrous with small and rounded anterolateral warts adjacent antennal socket. Scape 0.8 mm long, cylindrical (holotype with right antenna missing). Maxillary palps similar to those of *L. crepusculum* nov.sp., each 0.55 mm, first segment 0.4 mm and second segment 0.15 mm. Forewings (Fig. 53) each 5.9 mm long and 1.9 mm wide, basal pocket absent, anal groove extended distad almost as far as thyridial cell. Hind wings each 4.1 mm long, 1.5 mm wide. Mesonotum: scutal warts each nearly circular with posteromesal margin pointed; scutellar warts each D-shaped with mesal margin straight and lateral margin semicircular.

**Genitalia** (Figs 54-58). Segment IX length of venter 2X as long as dorsum, posterior margin concave in lateral view. Segment X symmetrical, dorsomesal processes with bases widely separated and apices close together, each 3.5X as long as basal width, acuminate and directed posterad in dorsal view; irregular, basal 1/3 with dorsal margin curved ventrad and ventral margin concave, and apical 2/3 blade-like with dorsal margin curved and ventral margin nearly straight and directed dorsoposterad in lateral view; dorsolateral processes each short, lobiform, length 1/5 as long as dorsomesal process and directed posterad. Inferior appendages each having first article oblong with broad base, dorsal margin slightly concave, basal 2/3 with ventral flange, apex rounded and bearing irregular apical horn in lateral view; base very broad, apical portion slender and strongly curved mesad in ventral view; apical horn comprising several thick setae fused together and shaped like cow horn, with basal 2/3 directed mesad and apical portion curved posterad; having 1) basodorsal process slender, fingerlike and inclined posterad, length 1/3 that of main article; 2) second article in subapical mesal position, slender, sinuate, vermiform and extended dorsomesad; and 3) ventromesal process absent. Phallicata base curved slightly ventrad, apical portion directed posterad; parameres symmetrical, slender, nearly straight with apical 1/5 acuminate and bent slightly ventromesad.

**E t y m o l o g y .** Greek: *moschos*, calf (noun) and *ceros*, horn (noun); named after the small cow horn-shaped apical processes of the inferior appendages in ventral view.



**Figs 53-58:** *Lepidostoma moschoceros* nov.sp., ♂; (53) right forewing; (54-58) genitalia: (54) lateral; (55) dorsal; (56) ventral; (57) phallus, lateral; (58) parameres, dorsal.

***Lepidostoma incomptum* nov.sp. (Figs 59-66)**

**H o l o t y p e :** ♂ in EtOH [AMNH]: Ha Giang, 1780 m, Malaise trap, 22.77N, 104.82E, 23.IX.2000, C. Johnson.

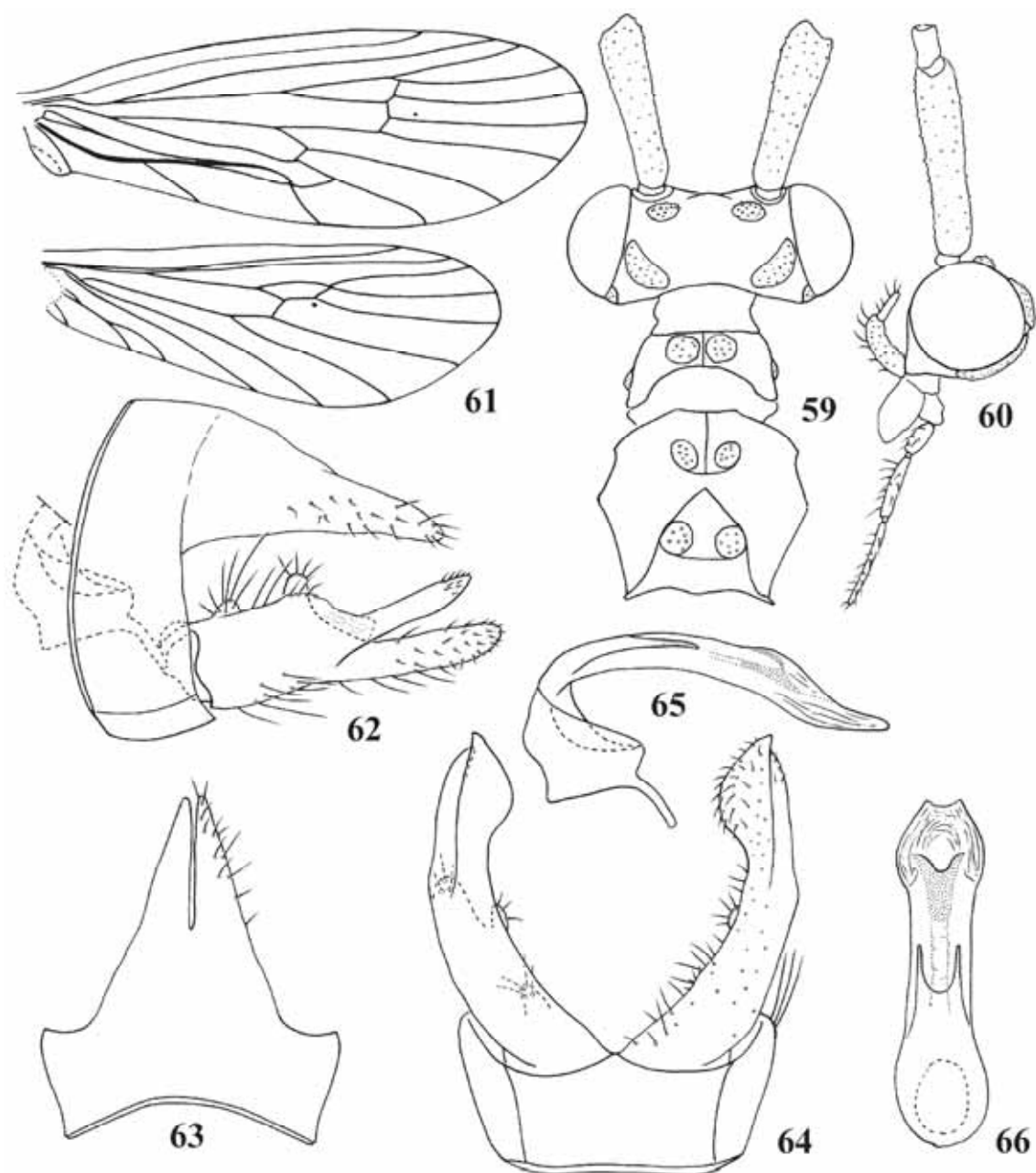
**D i a g n o s i s .** This species is similar to *L. parvum* (MOSELY 1941), but differs by having forewing without a postcostal fold and anal groove shorter, maxillary palp shorter with first segment fingerlike, segment X acuminate, inferior appendage with main article having apicomesal margin curved (not straight), and parameres reduced.

**D e s c r i p t i o n .** Male. Color yellowish, light brown. Head (Figs 59, 60) vertex minute rounded triangular and projected anterad; antennal warts small an elliptical; occipital warts reniform; frons slightly concave, anterolateral warts elongate, adjacent to eye margins and bearing long, slender scales. Scapes each 0.7 mm, straight and cylindrical. Maxillary palps each 0.35 mm and bearing long, slender scales; first segment 0.25 mm, fingerlike, curved dorsad apically and second segment 0.1 mm, slender lobiform. Forewings (Fig. 61) each 5.4 mm long and 4.4 mm wide; without postcostal cell, anal groove extended distad as far as apex of thyridial cell. Hind wings each 4.4 mm long, 1.6 mm wide. Mesonotum (Fig. 59): scutal warts nearly round; scutellar warts elliptical and larger than scutal warts.

Genitalia (Figs 62-66). Segment IX with dorsum and venter uniform in length. Segment X symmetrical, dorsomesal processes acuminate, about twice as long as basal height in lateral view, acuminate with basal 2/5 fused together and apical 3/5 separated by narrow mesal notch in dorsal view; other processes absent. Inferior appendages each with main article rectangular in lateral view; mesal margin smoothly curved in ventral view; having 1) basodorsal process reduced to short lobe with height less than basal width; 2) apicomesal process about twice as long as basomesal process, short lobiform and directed dorsad; 3) apicoventral process fingerlike extended posterad; 4) second article about 4/5 as long as apicoventral process, extended dorsoposterad in lateral view; and 5) ventromesal process absent. Phallicata curved ventroposterad, parameres greatly reduced.

**E t y m o l o g y .** Latin, *incomptus*, unadorned (adjective); named after having parameres reduced.





**Figs 59-66:** *Lepidostoma incomptum* nov.sp., ♂; (59) head and thorax, dorsal; (60) head, lateral; (61) right wings; (62-66) genitalia: (62) lateral; (63) dorsal; (64) ventral; (65-66) phallus: (65) lateral; (66) dorsal.

***Lepidostoma bamboo* nov.sp. (Figs 67-73)**

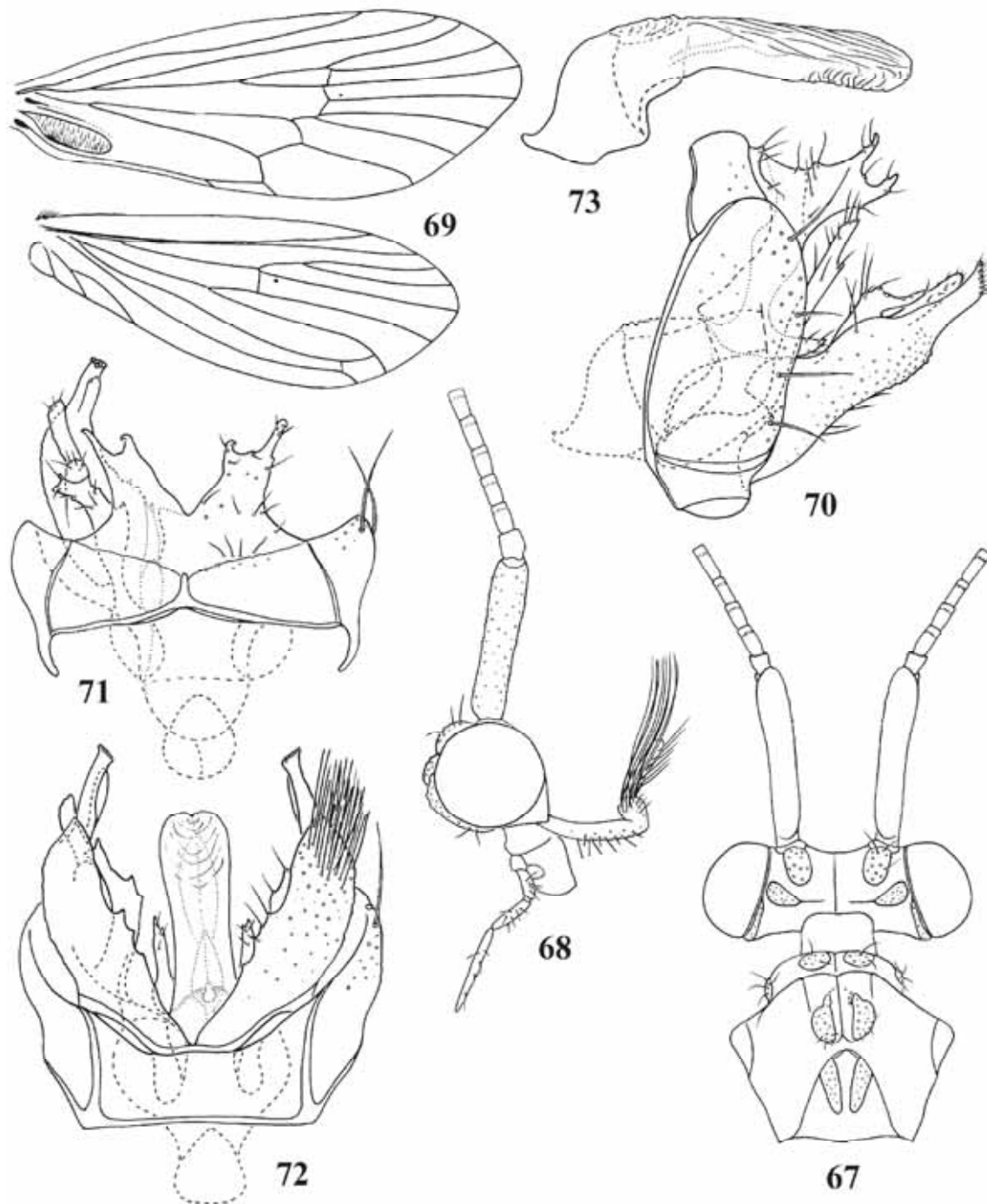
**H o l o t y p e :** ♂ in EtOH [ROM 992012]; Lao Cai, ca. 12 km along road from Sa Pa to Lai Chau, near 6 m wide stream in bamboo forest, 1950 m, Malaise trap, 22.35N, 103.77E, 1-12.V.1999, B Hubley. **O t h e r m a t e r i a l :** 1 ♀, same data as holotype.

**D i a g n o s i s .** This species is included in the *Lepidostoma ferox* branch; it is similar to *L. subtortus* YANG & WEAVER 2002 and *L. ratanapruksi* MALICKY & CHANTARAMONGKOL 1994 but differs by having male scape simple and cylindrical (without a mesal process); forewings with anal groove modified with a basoposterior elliptical callous; and, segment X with dorsomesal and ventrolateral processes short, slender, parallel and extended dorsoposterad in lateral view.

**D e s c r i p t i o n .** Male. Color brown. Head (Figs 67, 68) vertex without frontal projection, dorsoanterior margin nearly straight; antennal warts round, occipital warts rounded triangular, similar to size of antennal warts; frons glabrous, anterolateral warts each small, elliptical, in dorsolateral corner of frons and adjacent to eye margin. Scares each 0.87 mm, simple and cylindrical; flagella each with first 5 basal segments having each segment with a slender narrow subapical band which resembles brown banding at apex. Maxillary palps each with first segment 0.45 mm, apex curved dorsad, bearing long, slender setae apically; second segment 0.35 mm, extended directly dorsad and held adjacent to frons, surrounded and concealed by thick pile of long, slender setae, having setae mostly yellowish but brown apically. Wings (Fig. 69): forewings each 6.3 mm long and 2.4 mm wide, arculus in distal position and not interrupted by anal groove; anal groove modified with basal elliptical callous. Hind wings each 5.4 mm long and 2.1 mm wide, bearing short, stout scales between *R*<sub>5</sub> and *Ma* and adjacent to posterior margin, and long, slender column-like setae adjacent to *Mp* and *Cu*<sub>1</sub>, venation modified with *Cu*<sub>1</sub> joining *Mp* apically. Mesonotum (Fig. 67): scutal warts nearly elliptical; scutellar warts almost rectangular with mesal margins nearly straight and parallel, and lateral margins slightly angled, each tapered posterad.

**Genitalia** (Figs 70-73). Segment IX length of each pleuron twice that of dorsum, length of dorsum and venter subequal in lateral view; middle of dorsum especially short in dorsal view. Segment X symmetrical with main process trapezoidal, extended dorsoposterad, bearing dorsomesal processes each short slender, curved slightly dorsad and 1/3 as long as main process in lateral view; ventrolateral processes each slender, slightly irregular, directed dorsoposterad with length nearly equal to that of dorsomesal process in lateral view; dorsomesal processes appear shorter than ventrolateral processes in dorsal view. Inferior appendages each with first article irregular rectangular, directed dorsoposterad, dorsal and ventral margins sinuate in lateral view, mesal margin irregular, nearly straight, slanted laterally in ventral view; having 1) basodorsal process long, slender, nearly as long main article, extended dorsoposterad, apex obliquely truncated; 2) apicomesal process with basal half broader than apicomesal process, directed dorsoposterad; and apical half slender, curved ventrad at its base with remainder directed posterad; 3) apicoventral process about half as long as main article, nearly straight, directed dorsoposterad, apex obliquely truncated; 4) second article fingerlike, slightly shorter than apicoventral process, directed dorsoposterad in lateral view; and 5) ventromesal process absent. Phallobase bearing a pair of lateral processes, phallicata nearly straight and extended posterad; parameres absent.

**E t y m o l o g y .** This species is named for the bamboo forest in which the holotype was collected.



**Figs 67-73:** *Lepidostoma bamboo* nov.sp., ♂; (67) head and thorax, dorsal; (68) head, lateral; (69) right wings; (70-73) genitalia: (70) lateral; (71) dorsal; (72) ventral; (73) phallus, lateral.

***Lepidostoma timbaka* (MOSELY 1949) (Figs 74-77)**

*Lepidostoma timbaka* (MOSELY 1949b): 414-415, pl. 4, figs 106-111 (*Anacrunoecia*).

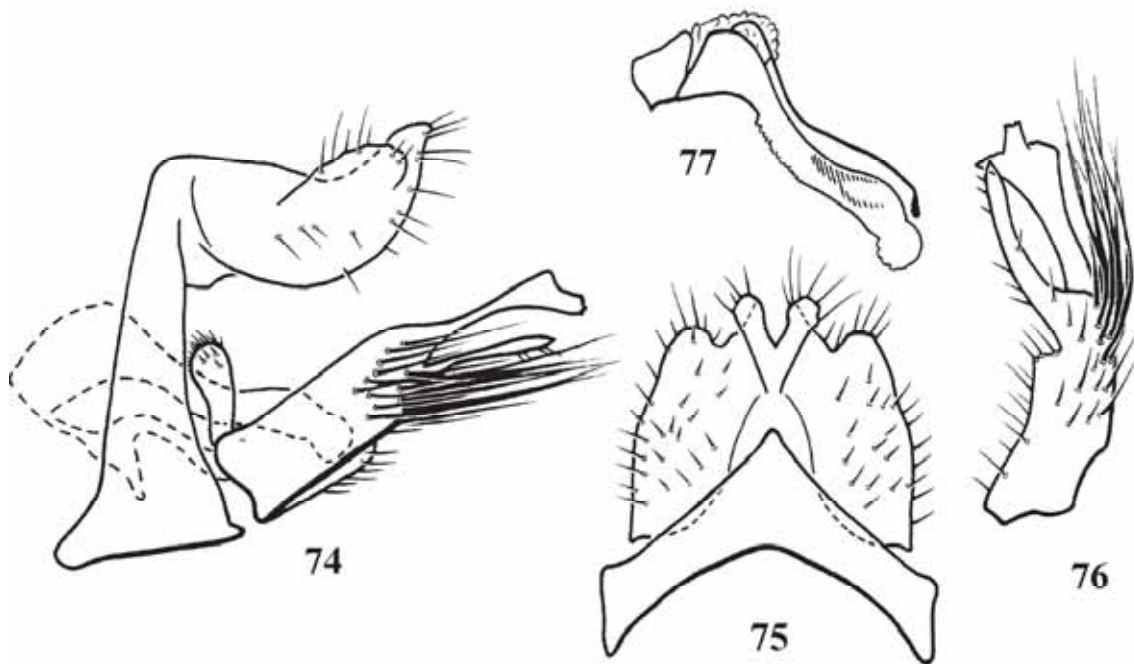
*Lepidostoma timbaka* (MOSELY 1949b). WEAVER 2002: 183, as new comb.

*Lepidostoma navasi* WEAVER 2002: 184, as new name. **nov.syn.**

*Crunociella hirta* NAVAS 1932. ARMITAGE et al. 2005: 33.

**Material examined:** Holotype of "*Crunociella hirta* NAVÁS" ♂ [MNHN] Chapa [= Sa Pa] Tonkin 1930. Holotype of "*Anacrunoecia timbaka* Mosely" ♂ [NHRS] NE Burma, Kambaiti, 7000 ft., 4-8.VI.1934, R. Malaise.

**Discussion.** Examination of the holotype of "*Crunociella hirta* NAVÁS" reveals that it is a male and not a female as reported previously, and that it is identical to the observed holotype of "*Anacrunoecia timbaka* Mosely. According to MOSELY'S original description of *L. timbaka*, the parameres, "penis-sheaths," are apparently absent; however, examination of the holotype reveals that the parameres are present, although reduced to a single slender capitate rod which follows the dorsal margin of the phallicata. The male genitalia (Figs 74-77) of the holotype from the Paris Museum are illustrated herein.



**Figs 74-77:** *Lepidostoma timbaka* (MOSELY 1949), ♂-genitalia.; (74) lateral; (75) dorsal; (76) left inferior appendage, ventral; (77) phallus, lateral.

***Lepidostoma dipterocarpium* nov.sp. (Figs 78-84)**

**H o l o t y p e :** ♂ in EtOH [ROM 2001503]: Thua Thien-Hue, Bach Ma National Park, Parashorea trail, Malaise trap, dipterocarp forest, dry stream bed, 9 km from park entrance, 16.20N, 107.85E, 1000 m, 26.V.-13.VI.2001, C. Darling & N. Tatarnic. **P a r a t y p e s :** 4♂♂, 6♀♀ in EtOH [ROM 2001503]: same data as holotype; 1♂ in EtOH [ROM 2000531]: Thua Thien-Hue, Bach Ma National Park, near junction of Rhododendron trail and Five Lakes trail, Mercury vapor light, field at edge of semitropical evergreen forest, 1200 m, 16.19N, 107.85E, 16.VI.2000, B. Hubley & C. Darling; 1♂, 1♀ in EtOH [AMNH]: Quang Nam, Ngoc Linh, 950 m, Malaise trap, 15.17N, 108.08E, 23.III.1999, K. Long & C. Johnson; 3♂♂ in EtOH [AMNH]: *ibid.*, 16.IV.1999.

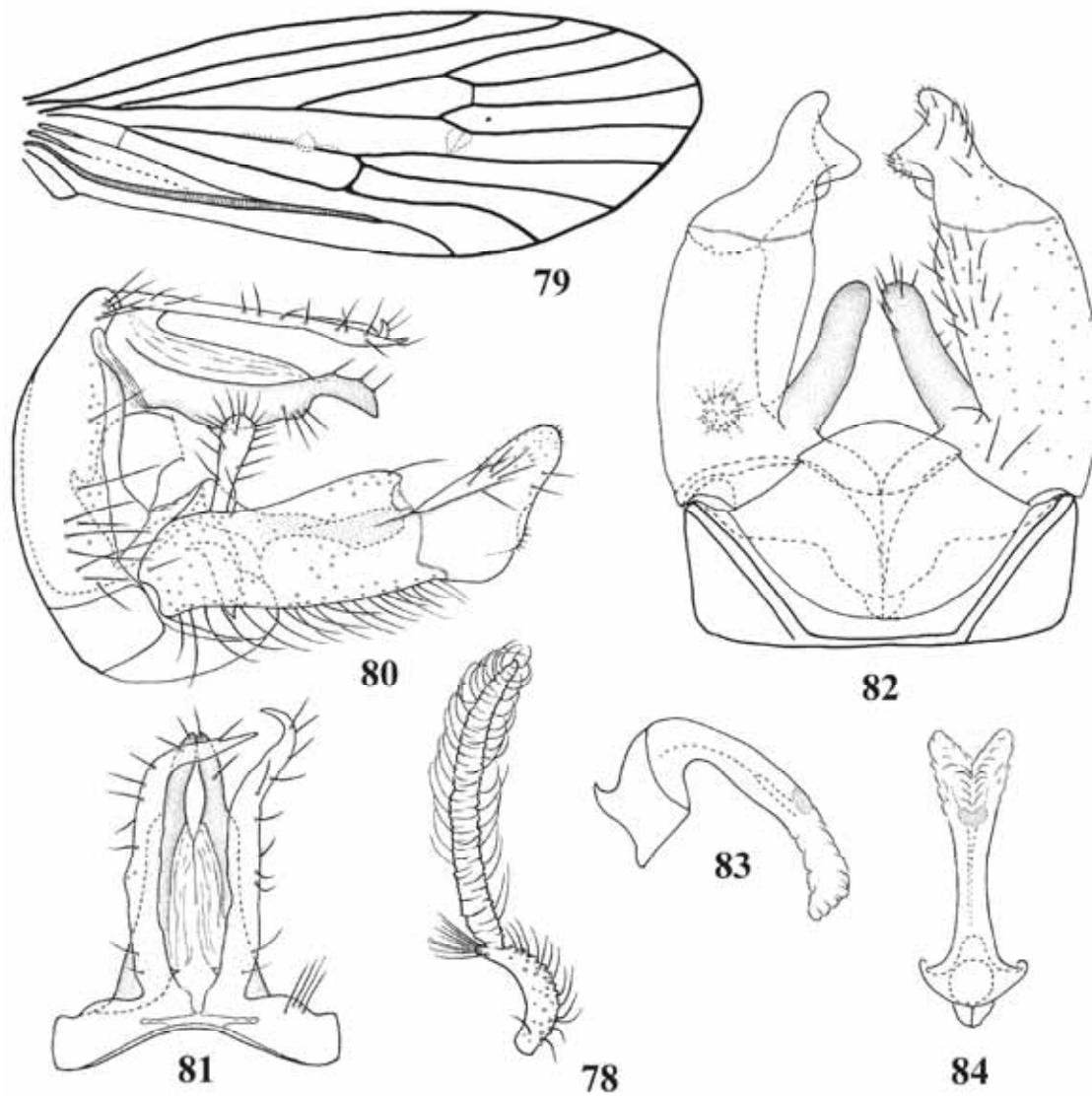
**D i a g n o s i s .** This species is included in the *Lepidostoma hirtum* branch; it is similar to *L. montatan* MALICKY & CHANTARAMONGKOL 1994, but differs by having male scape simple and cylindrical, segment X with left dorsomesal process not bifid apically, and inferior appendage with ventromesal process broad and fingerlike in ventral view.

**D e s c r i p t i o n .** Male. Color light brown. Head vertex with small frontal projection, antennal warts small and nearly round, occipital warts large and oblong; frons with anterolateral warts very small, round. Scapes each 0.75 mm long, simple, cylindrical. Maxillary palps (Fig. 78) each 1.45 mm long, first segment 0.35 mm; second segment 1.1 mm, flexible and covered with fine whitish setae. Forewings (Fig. 79) 6.0 mm long, 2.0 mm wide, without basal pocket, anal groove extended slightly beyond thyridial cell. Hind wings each 4.7 mm long, 1.5 mm wide. Mesonotum with scutal and scutellar warts typical, small and elliptical.

**Genitalia** (Figs 80-84). Segment IX slender, ringlike, length of dorsum 0.4X that of venter in lateral view. Segment X with dorsomesal processes strongly asymmetrical, long, slender, rodlike, basal 2/3 nearly straight, parallel and directed posterad; left process, apical 1/3 sinuate with apical point curved right; left process with apical 1/3 bent left with apical point directed dorsad; and intermediate lateral processes each with heavily sclerotized lateral portion and weakly sclerotized dorsomesal portion; lateral portion 5X as long as basal height, curved slightly, extended posterad, apical 1/4 having ventral margin excised, with apex trapezoidal and inclined slightly ventrad in lateral view. Inferior appendages each with first article broad and rectangular, length over 2X basal height; having 1) basodorsal process clavate, nearly straight, length 1/3 as long as main article; 2) second article rounded triangular with basodorsal margin indented from dorsal margin of main article in lateral view; bent mesad, tapered in middle, apex bilobed with mesal margin concave in ventral view; 3) ventromesal processes each thumblike, length 2/3 that of main article, directed posteromesad in ventral view. Phallicata curved ventrad at base; parameres absent.

**E t y m o l o g y .** This species is named after the dipterocarp (adjective) forest type in which it was collected.





**Figs 78-84:** *Lepidostoma dipterocarpium* nov.sp., ♂; (78) right maxillary palp, lateral; (79) right forewing; (80-84) genitalia: (80) lateral; (81) dorsal; (82) ventral; (83-84) phallus: (83) lateral; (84) dorsal.

***Lepidostoma hinnuleus* nov.sp. (Figs 85-91)**

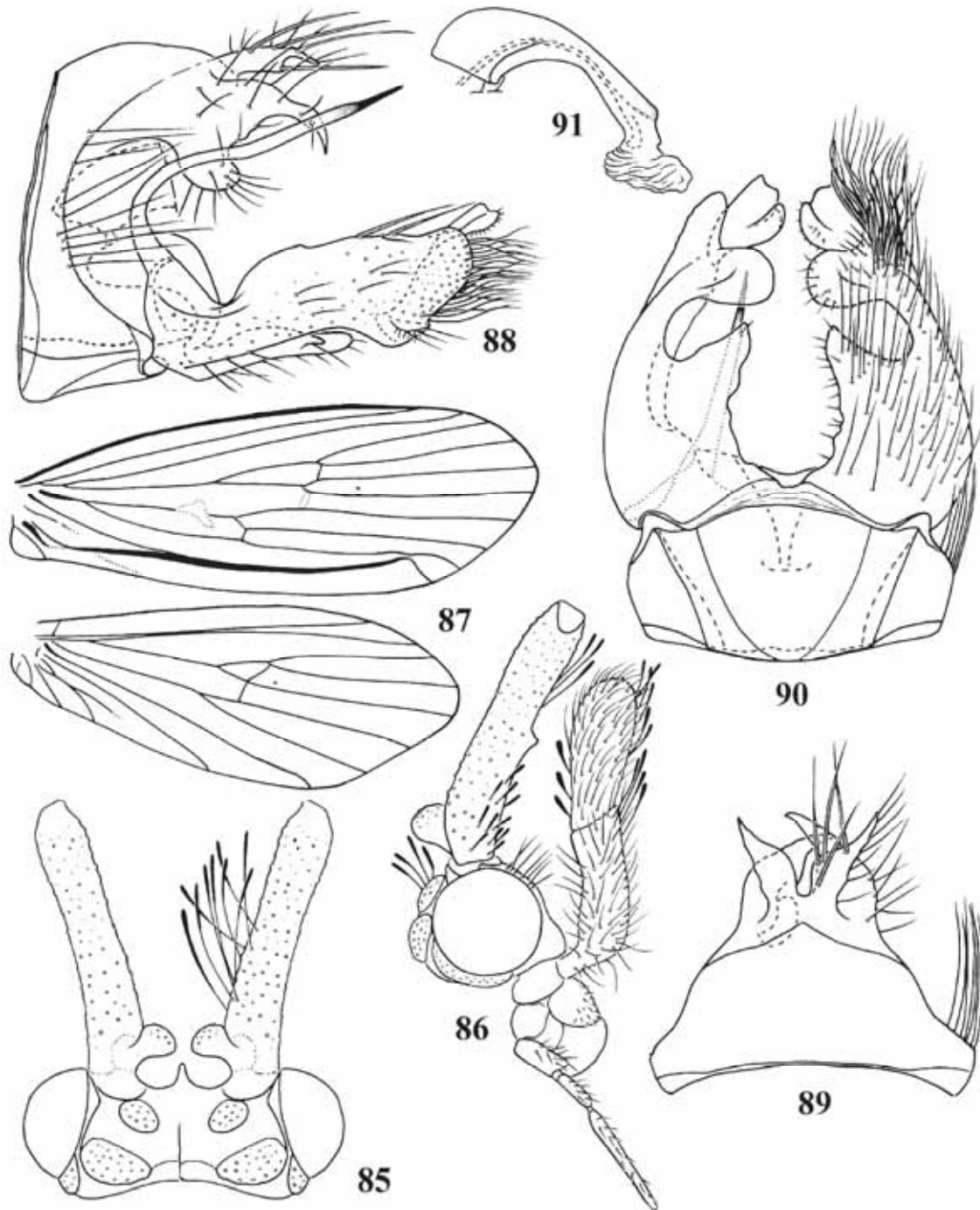
**H o l o t y p e :** ♂ in EtOH [ROM 956040]: Lao Cai, 1.5 m wide stream near mt. pass on road from Sa Pa to Lai Chau, Malaise trap, 2<sup>o</sup> growth, 8-12.V.1995, D. Currie & J. Swann. **P a r a t y p e s :** 1 ♂, 1 ♀, same data as holotype.

**D i a g n o s i s .** This species is included in the *Lepidostoma hirtum* branch; it is similar to *Lepidostoma varithi* MALICKY & CHANTARAMONGKOL 1994, but differs by having male scape with short knoblike basodorsal process; forewing without postcostal fold; inferior appendage with basodorsal process longer, extending posterad beyond processes of segment X; and phallicata with apex expanded.

**D e s c r i p t i o n .** Male. Color mostly brown, with some dark brown and cream colored areas highlighted. Head (Figs 85, 86) vertex with small, triangular projection, stout elliptical, antennal warts almond-shaped and larger than antennal warts, tricolored, mostly brown with posterior margin, parts of occipital warts, and bases of maxillae dark brown, and areas at base of antennae whitish; frons, anterolateral warts large and bearing dense patch of brown scales (however paratype male with fewer dark brown areas, perhaps teneral). Scares each 1.4 mm, cylindrical, and bearing basodorsal spherical process and minute ventral process at mid-length. Maxillary palps broad and extended anterad; first segment 0.8 mm, about twice as long as broad, yellowish white, bearing long mesal tuft of long, slender, yellowish white setae extended anterad and shorter, slender brown scales; second segment 0.7 mm, ligulate, bearing slender brown scales in lateral view. Wings (Fig. 87); forewings each 9.4 mm long, 3.7 mm wide, anal groove slender and extended distad as far as apex of Sc. Hind wings each 7.6 mm long and 3.3 mm wide, venation typical. Mesonotum: scutal warts round; scutellar warts almost round slightly elliptical, bicolored being mostly brown with hourglass, yellowish area surrounding warts.

**Genitalia** (Figs 88-91). Segment IX length of dorsum nearly equal to that of venter; minimum length of each pleuron less than 1/3 that of venter in lateral view. Segment X slightly asymmetrical with dorsomesal processes each irregular, directed posterad, apical 1/3 slender, curved ventrad slightly with ventral margin incised; intermediate lateral processes each slender, hook-shaped with apex curved ventrad; ventrolateral processes each lobiform and directed ventrad in lateral view. Inferior appendages each with first article irregular rectangular, having dorsal margin deeply incised distal to base of basodorsal process in lateral view; mesal margin bearing large triangular process (= ventromesal process) in ventral view; having 1) basodorsal process slender and spiniform, basal 1/4 directed dorsad and slanted anterad slightly, and distal 3/4 directed posterad and nearly straight in lateral view; 2) apicomesal process absent; 3) apicoventral process semicircular directed mesad in ventral view; 4) second article short and irregular, capitate with dorsal surface of apical portion concave and posterior margin incised; and 5) ventromesal process lobiform and directed posterad in lateral view. Phallicata with base curved ventrad and apex bulbous; parameres absent.

**E t y m o l o g y .** Latin, *hinnuleus*, young stag (noun); named for having antennal scapes with short stubby horns.



**Figs 85-91:** *Lepidostoma hinnuleus* nov.sp., ♂; (85) head, dorsal; (86) head, lateral; (87) right wings; (88-91) genitalia: (88) lateral; (89) dorsal; (90) ventral; (91) phallus, lateral.

**Table 1:** Species checklist of Vietnamese Lepidostomatidae [type country; other countries].

***Zephyropsyche* WEAVER**

*Zephyropsyche weaveri* MALICKY & CHANTARAMONGKOL 1994 [Thailand; Vietnam]

***Paraphlegopteryx* ULMER**

*Paraphlegopteryx malickyi* WEAVER 1999 [Thailand; Vietnam]

*Paraphlegopteryx meyi* WEAVER 1999 [Vietnam]

*Paraphlegopteryx tonkinensis* ULMER 1907 [Vietnam]

***Lepidostoma* RAMBUR**

***Lepidostoma ferox* branch**

*Lepidostoma erech* MALICKY 2008 [Vietnam]

*Lepidostoma esau* MALICKY 2008 [Vietnam]

*Lepidostoma esban* MALICKY 2008 [Vietnam]

*Lepidostoma ezer* MALICKY 2008 [Vietnam]

*Lepidostoma gad* MALICKY 2008 [Vietnam]

*Lepidostoma gomer* MALICKY 2009 [Vietnam]

*Lepidostoma timbaka* (MOSELY 1949b) [Myanmar; Thailand, Vietnam]

*Lepidostoma hansmalickyi* nov.sp. [Vietnam]

*Lepidostoma wolframi* nov.sp. [Vietnam]

*Lepidostoma fansipanense* nov.sp. [Vietnam]

*Lepidostoma laocai* nov.sp. [Vietnam]

*Lepidostoma teuthis* nov.sp. [Vietnam]

*Lepidostoma cataracta* nov.sp. [Vietnam]

*Lepidostoma crepusculum* nov.sp. [Vietnam]

*Lepidostoma moschoceros* nov.sp. [Vietnam]

*Lepidostoma incomptum* nov.sp. [Vietnam]

*Lepidostoma bamboo* nov.sp. [Vietnam]

***Lepidostoma hirtum* branch**

*Lepidostoma arcuatum* (HUANG 1957) [China; Vietnam]

*Lepidostoma doligung* (MALICKY 1979) [India (Andaman Islands); Cambodia, China, Indonesia (Sumatra), Taiwan, Vietnam]

*Lepidostoma montatan* MALICKY & CHANTARAMONGKOL 1994 [Thailand; Vietnam]

*Lepidostoma propriopalpa* (HUANG 1957) [China; Vietnam]

*Lepidostoma pseudabruptum* MALICKY & CHANTARAMONGKOL 1994 [Thailand; Vietnam]

*Lepidostoma dipterocarpium* nov.sp. [Vietnam]

*Lepidostoma hinnuleus* nov.sp. [Vietnam]

## Acknowledgements

We thank Sacha Spector, American Museum of Natural History, New York, U.S.A.; Wolfram Mey, Museum für Naturkunde der Humboldt-Universität zu Berlin, Germany; Jean Legrand, Muséum National d'Histoire Naturelle, Paris, France; Torbjörn Kronestedt & Kjell Arne Johanson, Naturhistoriska Riksmuseet, Stockholm; and, Doug Currie, Royal Ontario Museum, Toronto, Canada for providing specimens and other assistance during this study. This paper is ROM publication number 343 of the ROM's Department of Natural History.

## Zusammenfassung

Die vietnamesischen Lepidostomatidae (Trichoptera) umfassen drei Gattungen (*Zephyropsyche*, *Paraphlegopteryx* und *Lepidostoma*). Von den 24 *Lepidostoma*-Arten, von denen 12 hier beschrieben werden, gehören 17 zur *Lepidostoma ferox*-Gruppe und sieben zur *L. hirtum*-Gruppe. Die neuen Arten sind *Lepidostoma hansmalickyi*, *L. wolframi*, *L. fansipanense*, *L. laocai*, *L. teuthis*, *L. cataracta*, *L. crepusculum*, *L. moschoceros*, *L. incomptum*, *L. bamboo*, *L. dipterocarpium* und *L. hinnuleus*. *Lepidostoma navasi* WEAVER 2002 ist ein jüngeres Synonym von *L. timbaka* (MOSELY 1949).

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Artikel/Article: [The Caddisfly Family Lepidostomatidae \(Trichoptera\) in Vietnam 407-435](#)