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Aquatic Dance Flies from a Small Himalayan Mountain Stream (Diptera: Empididae: Hemerodromiinae, Trichopezinae and Clinocerinae)

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Abstract: For the first time an emergence trap was permanently run for almost two years over a Himalayan stream (Kullu Valley, SW-Himalayas, Himachal Pradesh, India). The area is situated in monsoon climate. We report the results of the emergence of aquatic dance flies (Empididae: Hemerodromiinae, Trichopezinae and Clinocerinae). Forty-nine taxa were distinguished, and thirty-three were determined to species level; seventeen species were new to science. In Hemerodromiinae four new species of the genus *Hemerodromia* Meigen, 1822, and ten of *Chelifera* Macquart, 1823, were found over approx. 5 m² of stream surface. One species of *Heleodromia* Haliday, 1833, subfamily Trichopezinae, was new. In Clinocerinae, two species of *Dolichocephala* Macquart, 1823, three of *Roederiodes* Coquillett, 1901, seven of *Clinocera* Meigen, 1803 and one of *Trichoclinocera* Collin, 1941, were new to science. Species and specimen number of Clinocerinae, particularly *Wiedemannia glaucescens* (BRUNETTI 1917), were highest at high precipitation; Hemerodromiinae were more abundant during the dry periods. Species richness is remarkably high, compared with studies on European or North American streams. Probably many endemics exist. Morphological similarity of several *Clinocera* species indicates intense speciation processes. Species richness may further depend on the position of the Himalayas between the Palaearctic and the Oriental region, and the vicinity of climatic zones along the different elevations and slopes of the mountain chains. Provisional keys for the genera *Chelifera*, *Hemerodromia*, *Heleodromia* and *Clinocera* are provided.

Key words: Himalaya, stream, aquatic Empididae, new species, emergence patterns, environmental variables, species richness, Oriental Region.

1. INTRODUCTION

Research on running waters mainly yields data from streams and rivers in the industrialised “western” world. Data on biodiversity and ecology of streams in Asia are comparatively rare (DUDGEON 1982, 2000a, 2000b). The elucidation of the biodiversity of a mountain brook is a task for which the best methodology is the collection of adult aquatic insects with emergence traps in addition to benthos samples and life cycle studies. Such data were gained for a Himalayan stream in the Kullu-Valley (SW-Himalayas, Himachal Pradesh, India) during an Indo-German Project 1994-1999 (PANESAR 1998) and during a study supported by the Indian Ministry for Human Resource Development, which concentrated on a caddis fly species (KAISER 1999). Both projects were aimed for the development of a bio-monitoring method for the assessment of water quality in India and showed the severe need for ecological data on macro-zoobenthos organisms at the species level (PANESAR 1995). To get such information for long-term studies the material was given to experts and results are expected to be published subsequently for the different groups. To date, only smaller parts of the data are published (STAUDER 2000, PANESAR in press), or have been included in Project Reports (e. g. PANESAR 1998).

The current publication deals with a family of aquatic Diptera, the dance flies or Empididae. The family in the new sense (CHVÁLA 1983) includes the subfamilies Empidinae, Hemerodrominae and Clinocerinae. Only the last two groups almost exclusively include species with larval development in aquatic habitats. Information on these groups from the Indian subcontinent or neighbouring regions are rare (GROOTAERT et al. 2000, HORVAT 2002, SINCLAIR 1994, SMITH 1965, 1975, VAILLANT 1960, WAGNER 1983, YANG & YANG 1988, 1995 a, b).

2. THE STUDY SITE

The study site is situated in the Kullu Valley (Fig. 1), province Himachal Pradesh, North-West India about 450 km N of Delhi that extends some 70 km from Bajaura in the south to the Manali area in the north with the Beas River a tributary of the famous Indian Ganges as a central axis and focus (31°27'N, 76°56'E / 31°26'N, 77°52'E). The Upper Beas basin is encircled by high Himalayan ranges up to 6,500 m, and thus its microclimate is characterised by a cool, snowy winter, and a relatively warm, wet monsoon summer.

The morphology of the Kullu Valley has been formed by glaciation with a broad, U-shaped cross-sectional

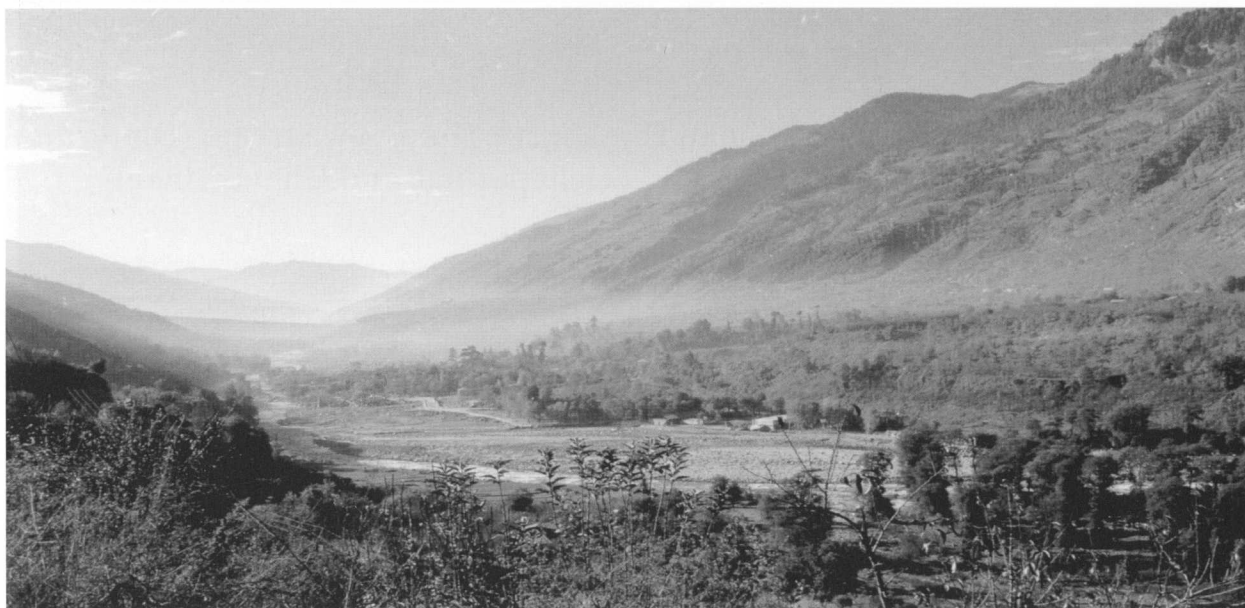


Fig. 1. The upper Kullu Valley south of Naggar with the Beas River (photo by O. Kaiser).

profile. Elevation of the valley bottom at Manali is approx. 2,000 m, and at Kullu 1,200 m.

The Naggar Nala is a first order stream originating at 2,600 m and flows into the Beas River after about 4 km at 1,420 m. The sampling site is situated south of the village Naggar at the border between forest and meadowland at 1,900 m.

The drainage area upstream from the study site is approximately 3.5 km². Mean stream discharge was about 20 l sec⁻¹, and stream width 1.2 – 1.5 m. The slope is low in the area near the study site and the stream sediment is dominated by gravel up to 20 cm in diameter. Conductivity was 160–230 µS cm⁻¹ with decreasing values during periods of high discharge following rainfalls.

Fifty percent of the annual precipitation at Naggar (about 1,200 mm) falls during the summer monsoon in July, August and September (SINGH 1989). The tree line in the Upper Beas watershed is at about 3,500 m. The landscape below is dominated by mixed deciduous coniferous forest, interspersed with meadows, grading into extensive areas of Himalayan coniferous forest at lower elevations. On the lower valley slopes, this forest type changes into small pockets of temperate forests and large agriculturally dominated areas, mainly fodder production, orchards, horticulture, grain and, at lower elevations, rice cultivation. Characteristic for the agricultural system of the Kullu Valley are small-scaled terrace cultivation and household agricultural land holdings in the form of discrete parcels within the village area (SINGH 1998).

3. MATERIALS & METHODS

Aquatic insects were collected in an emergence trap (MARTEN & ZWICK 1999) covering an area of approx 5 m² of the Naggar Nala (nala=stream, Fig. 2).

The trap was emptied daily and specimens were preserved in 10% formalin. The material worked out for the present publication was collected between July 1996 and December 1997. Samples were taken by A. STAUDER and A. R. PANESAR (STAUDER 2000) and by O. KAISER (KAISER 1999).

As precipitation varies strongly even between small areas in the study area the daily rainfall and data on water and air temperatures were measured next to the sampling site.

Most species of aquatic Empididae (subfamilies Hemerodromiinae, Trichopezinae and Clinocerinae) discussed below are new to science. Holotypes are deposited in Museum Koenig, Bonn, Germany (ZFMK). If available, paratypes are deposited at the Zoological Survey of India, New Alipore, Calcutta, India (NZSI), and the Naturhistorisches Museum Basel, Switzerland (NHMB). The remaining material is in the collection of the senior author at the Limnologische Fluss-Station Schlitz, Germany (LFSS).

Species descriptions in Clinocerinae in particular refer to number of bristles and the following abbreviations are used: oc=ocellar bristles; poc=post-ocellar bristles; pb=pronotum bristles; dc=dorsocentral bristles; ac=acrostichal bristles. All bristles occur in pairs on the left and right part of the body, i.e. 5 dc means 5 pairs of dorsocentral bristles. Terminology of male genitalia follows SINCLAIR (2000).



Fig. 2. Emergence trap at Naggar Nala during the summer monsoon (photo by A. Stauder).

4. TAXONOMY

Subfamily Hemerodromiinae

Genus *Chelifera* Macquart, 1823

Type-species: *Chelifera raptor* Macquart (by monotypy)

Chelifera contains species with raptorial front legs, wing with discal cell, i.e. two cross-veins between M_{1+2} and M_3 . SMITH (1965) recorded only a single female from Nepal; all species collected on the Naggar stream were new. Key to Himalayan species in Appendix I.

In the West-Palearctic, *Chelifera* species groups may be distinguished by means of body colouration, possession and number of mesonotal stripes, and presence or absence of a stigma. These were valuable features for the Himalayan species as well. We distinguished the following species groups:

Chelifera multiseta group, *Chelifera rhombicerca* group, and some unassigned species (*incertae sedis*). Four undescribed species were represented by females only and could not be positively assigned to males.

Chelifera multiseta group

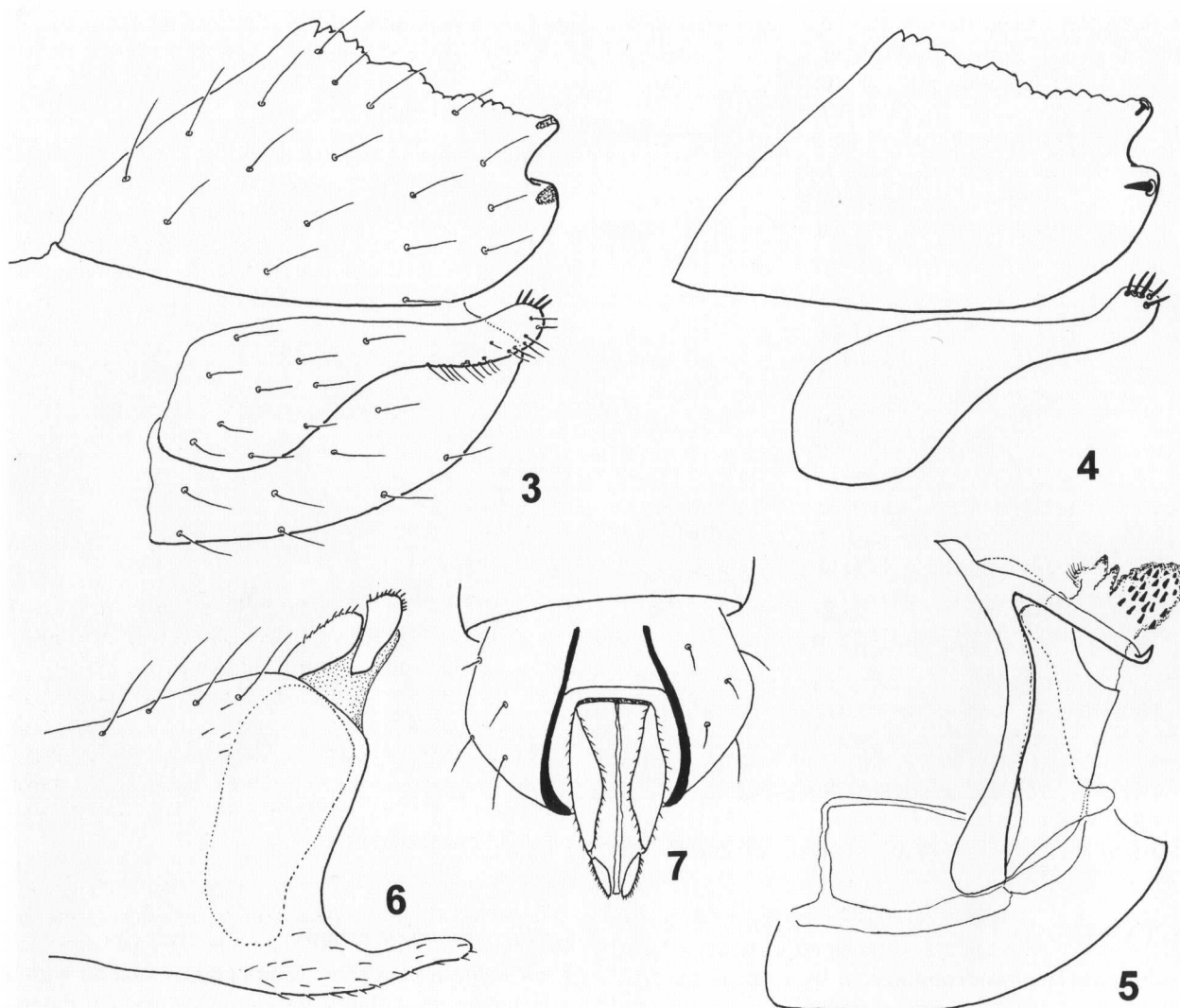
The *Chelifera multiseta* group includes species with a dark brown head, and a light brown to brown thorax; stigma faint, more or less elongate. The group contains *Chelifera multiseta*, *C. multisetoides*, and *C. insueta*. *C. malickyi*, recently described from Thailand (HORVAT 2002), is a close relative of this group due to thorax colouration and the shape of male genitalia.

Chelifera insueta Wagner & Leese sp. nov. (Figs 3-7)

Material. Holotype: 1♂ 25.06.1997 (ZMFK); Paratypes: 1♂ 06.06.1997 (NZSI); 1♂ 02.07.1997 (NHMB); further material: 2♀ 02.07.1997; 1♀ 05.07.1997; 3♀ 07.07.1997; 2♀ 08.07.1997; 1♀ 10.07.1997; 1♀ 12.07.1997; 1♀ 21.10.1997 (LFSS).

Description. Male. Head with yellow antenna and mouth parts. Thorax light brown, mesonotum with pair of lateral longitudinal brown streaks. Scutellum light brown, metanotum dark brown. Legs yellow, all tarsi with segments 4 and 5 blackish, more distinct in middle and hind tarsi. Middle tibia with about 17 elongate ventral setae. Abdominal tergites brown, sternites clear.

Genitalia. Hypandrium elongate, slightly bent, with caudal tip. Postgonite broad elongate, with long subapical horizontal appendage bearing short distal hook. Hy-



Figs. 3-7. *Chelifera insueta* sp. nov.: 3. genitalia, lateral view; 4. epandrium and cercus, inner view; 5. hypandrium and phallus, lateral view; 6. tip of female abdomen, lateral view; 7. tip of female abdomen, dorsal view.

pandrial process absent. Sheath of phallus is broad. Phallus upright, distal portion covered by numerous short spines. Epandrium elongate, basally quadrate, thinner in distal half, with 5 elongate bristles on inner tip. Cercus rhomboid, basal and anterodorsal margins smooth, posterodorsal margin irregularly serrate. Distal side with U-shaped incision, internally at tips of U with strong short setae.

Female. Colour pattern of head and thorax as in male. Middle tibia without elongate ventral bristles. Abdominal tergites brown with some lighter circular spots, sternites clear. Genitalia unique. Last abdominal segment uniformly brown, with white ventral, hook-shaped appendage (Figs 5-6, compare female of spec 3).

Measurements. Body length ♂ 4.8-5.5 mm, ♀ 3.8-5.0 mm. Wing length ♂ 4.2-4.9 mm, ♀ 3.7-4.9 mm.

Derivatio nominis. From *insuetus* (latin=unusual), concerning the shape of male and female genitalia.

Relations and remarks. It is difficult to decide whether males and females belong to the same species, but the abundance and amount of specimens of both sexes made it most probable for this species. The shape of the postgonite is unique, especially its elongate distal appendage and the construction of the phallus. In females the distal part of the abdomen with a broad dorsal 'plate' and the elastic elongate ventral appendage is unusual. It is similar to the female of *Chelifera* spec. 3, which differs in thoracic colouration.

***Chelifera multiseta* Wagner & Leese sp. nov.**
(Figs 8-11)

Material. Holotype: 1♂ 14.10.1996 (ZFMK); Paratype: 1♂ 24.04.1998 (NZSI); further material: 1♀ 24.10.1996 (ZFMK).

Description. Head dark brown, eye red, antenna and mouth parts yellow. Thorax light brown, mesonotum with pair of longitudinal brown streaks, increasing in width towards scutellum; streaks join before scutellum to form U-shaped pattern. Scutellum light brown, metanotum dark brown. Front legs entirely yellow, middle and hind legs yellow with tarsal segments 3-5 blackish. Abdominal tergites dark brown, sternites translucent.

Male genitalia. Hypandrium with blunt tip and 2 dorsal prolongations, anterior postgonite thin, elongate and slightly bent, distal hypandrial process shorter and straight, about 1/3 length of the postgonite. Phallus upright, just before flagellum with corona of black spines. Epandrium elongate, distally curved dorsally, inner side near apex with approx. 10 strong uniserial setae. Cercus rhomboid in lateral view, inner side along dorsal margin with irregular row of strong setae. In dorsal view cercus slightly bent, setae clearly visible to tip of cercus.

Measurements. Body length ♂ 3.2-4.0 mm, ♀ 2.7 mm. Wing length ♂ 3.3-4.3 mm, ♀ 3.2 mm.

Derivatio nominis. Derived from the large number of setae on the inner side of cercus.

***Chelifera multisetoides* Wagner & Leese sp. nov.**
(Figs 12-15)

Material. Holotype: 1♂ 18.09.1996 (ZFMK); Paratype: 1♂ 31.03.1997 (NZSI).

Description. Male. Head black, antenna and mouth parts yellow. Mesonotum with pair of broad, laterally irregular brown streaks. Scutellum light brown, metanotum dark brown. Front legs entirely yellow, middle and hind legs yellow with tarsal segments 4 and 5 black, 3rd segment basally yellow, distally dark. Abdominal tergites dark brown, sternites translucent, clear.

Genitalia. Hypandrium with blunt tip and 2 dorsal prolongations; anterior postgonite thin, elongate and strongly bent, distal hypandrial process broad and half as long as postgonite. Phallus upright, just before flagellum with corona of black setae. Epandrium elongate sickle-shaped, distally on inner side near apex with approx. 6-8 strong uniserial setae. Cercus rectangular in lateral view, with row of strong setae on inner side along dorsal margin, that distally covers uppermost tip. In dorsal view cercus bent, setae clearly visible to tip of cercus.

Measurements. Body length 4.1-4.2 mm. Wing length 3.2 mm.

Relations. *C. multiseta* and *C. multisetoides* are close relatives, they can be clearly distinguished by the shape of the epandrium, the prolongations of the hypandrium, and the shape and pattern of the setae on the cercus.

Derivatio nominis. In general morphology, this species is very similar to *C. multiseta*.

***Chelifera rhombicercus* group**

Chelifera rhombicercus group species have a dark brown head and thorax (mesonotum at least), a distinct black stigma, antenna and mouth parts are yellow. Taxa included are *Chelifera rhombicercus*, *C. stauderae*, *C. curvata* and four undescribed species, which were represented by females only and could not be positively associated with males. The recently described *C. ornamenta* (China, Sichuan) (HORVAT 2002), is more distantly related to this group due to the lack of a stigma.

***Chelifera curvata* Wagner & Leese sp. nov.**
(Figs 16-17)

Material. Holotype: 1♂ 16.10.1997 (ZFMK); Paratype: 1♂ 13.10.1997 (NZSI).

Description. Male. Head black, antenna and mouth parts pale yellow. Thorax blackish brown, mesonotum shining, paler on distal third. Legs yellow, middle and hind legs with 3 terminal tarsal segments blackish. Middle tibia ventrally with row of 13 stronger setae. Abdominal tergites dark brown, tergites VII with U-shaped pattern, tergite VIII translucent; sternites I – V translucent, sternites I to VI translucent, VII slightly pigmented, VIII with thin anterior streak.

Genitalia. Black, hypandrium almost straight, distally thinner, with blunt tip, and basally with thin gonocoxal apodemes. Dorsal prolongations of hypandrium and phallus not visible. Epandrium evenly arched, with 1 strong seta on distal inner end, and few long setae along lower margin. Cercus evenly curved along lower margin. Dorsal margin sinuous, distal margin short truncate with 3 strong teeth, on upper and lower ends, and inner ventral prolongation. In dorsal view basal half of cercal lamellae almost parallel, more distally strongly divergent with 2 spines.

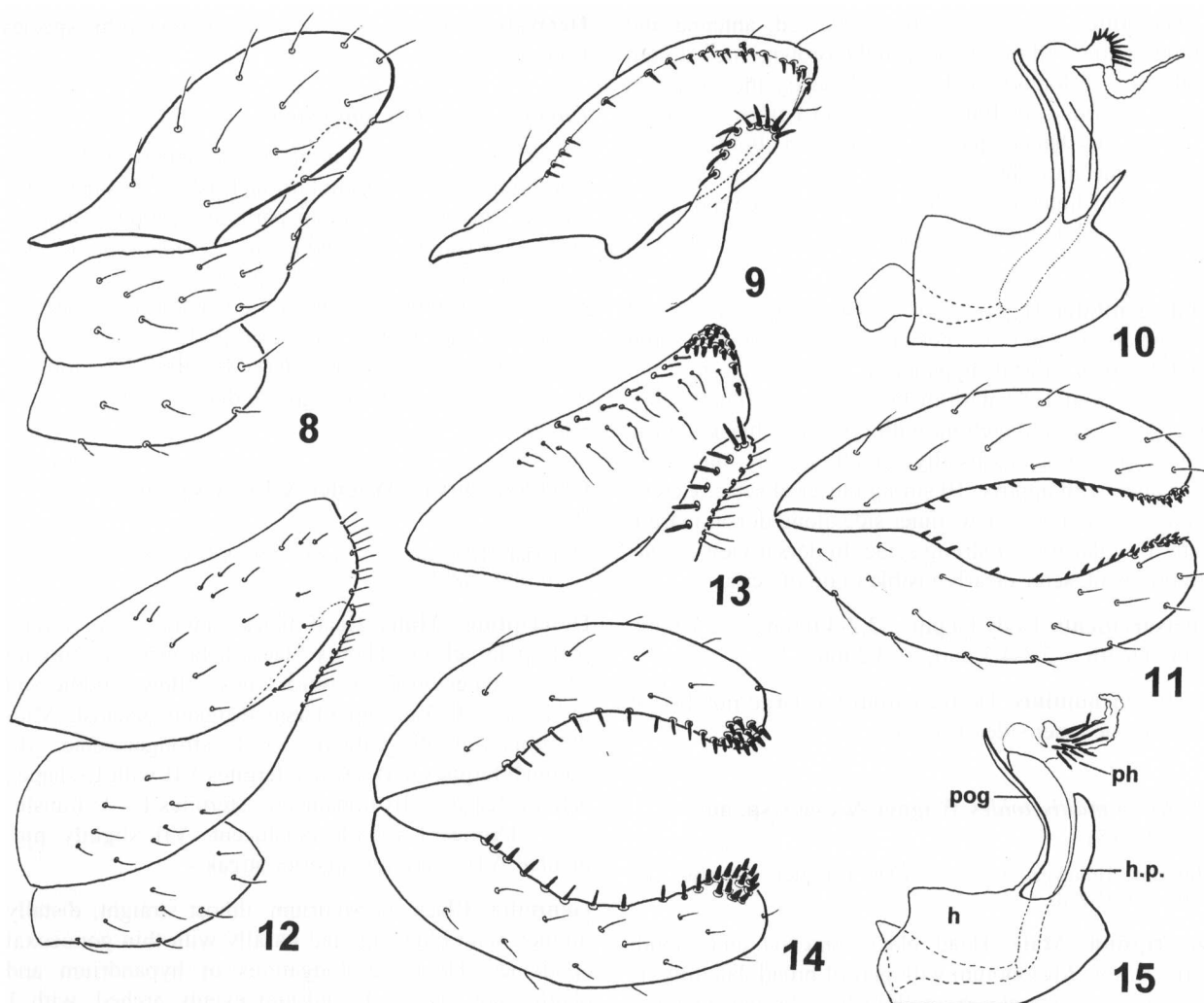
Measurements. Body length 4.3-5.8 mm. Wing length 3.7-4.5 mm.

Derivatio nominis. The strongly curved dorsal margin of the cercus is characteristic.

***Chelifera rhombicercus* Wagner & Leese sp. nov.**
(Figs 18-19)

Material. Holotype: 1♂ 27.08.1996 (ZFMK).

Description. Male. Head black, antenna and mouth parts pale yellow. Thorax dark brown, mesonotum paler on distal third. Legs yellow, middle and hind legs with 3 terminal tarsal segments blackish. Middle tibia ventrally with row of approx. 20 stronger setae. Abdominal tergites dark brown, colour pattern of tergites VI to VIII



Figs. 8-11. *Chelifera multiseta* sp. nov.: 8. genitalia, lateral view; 9. cercus and tip of epandrium, inner view; 10. hypandrium and phallus, lateral view; 11. cerci, dorsal view. **Figs. 12-15.** *Chelifera multisetoides* sp. nov.: 12. genitalia, lateral view; 13. cercus and tip of epandrium, inner view; 14. cerci, dorsal view; 15. hypandrium and phallus, lateral view. [h – hypandrium; pog – postgonite; ph – phallus; h.p. – hypandrial process].

U-shaped; sternites I – V translucent, sternites VI – VIII brownish along anterior margin.

Genitalia. Hypandrium slightly rounded and narrow, with blunt tip, basally with elongate gonocoxal apodemes. Dorsal prolongations of hypandrium and phallus not visible. Epandrium slightly bent, roughly triangular, no setae detected on distal end. Cercus large, rhomboid in lateral view, with 3 strong teeth on upper and lower ends of distal margin and inner ventral prolongation. In dorsal view basal half of cercal lamellae run almost parallel, then widely divergent with basal and distal spines.

Measurements. Body length 5.8 mm. Wing length 4.8 mm.

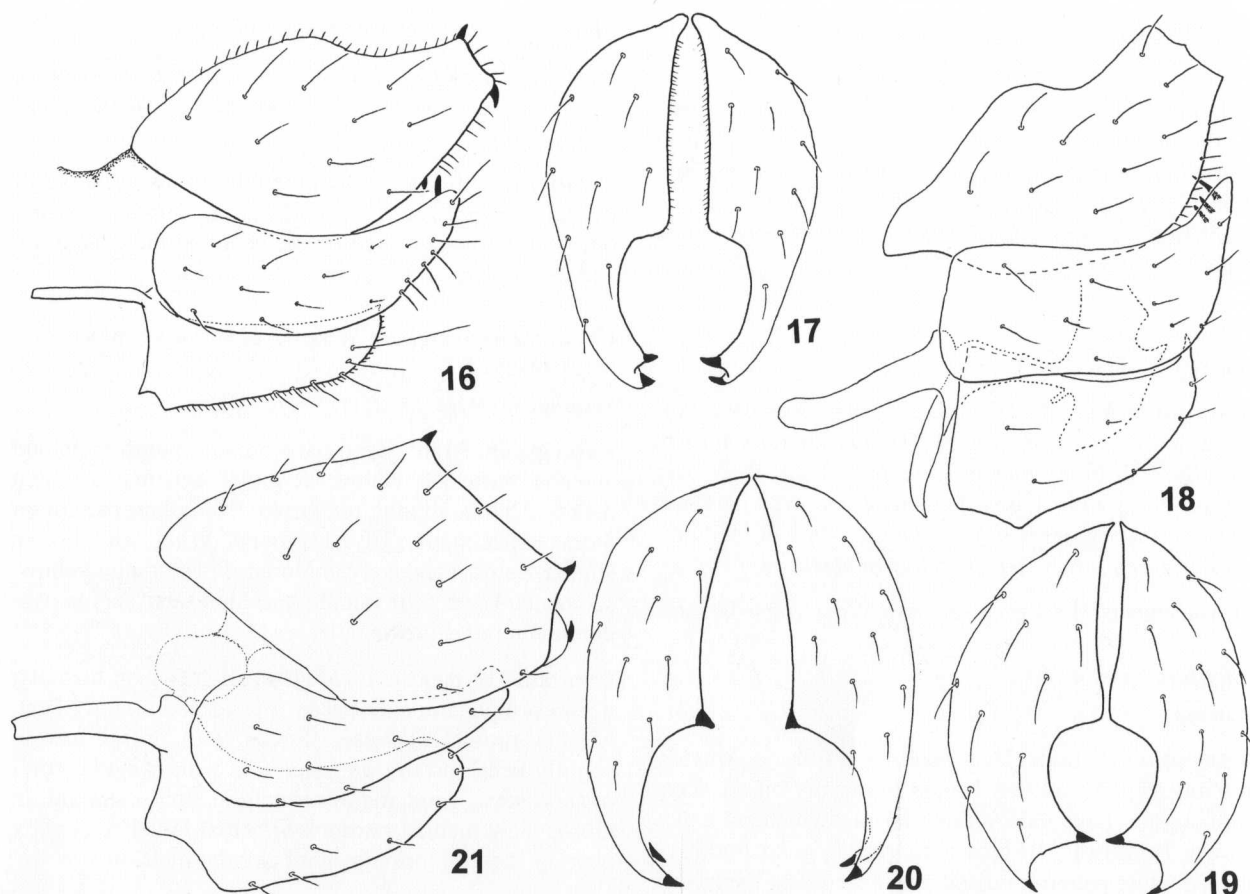
Derivatio nominis. Derived from the large, rhomboid cercus in lateral view.

***Chelifera stauderae* Wagner & Leese sp. nov.**
(Figs 20-21)

Material. Holotype: 1♂ 25.09.1996 (ZFMK).

Description. Male. Head black, antenna and mouth parts pale yellow. Thorax uniformly blackish brown, mesonotum paler in caudal third, scutellum just as pale. Legs yellow, middle and hind legs with tarsal segments 3 – 5 blackish. Middle tibia ventrally with row of approx. 17 stronger setae. Abdominal tergites dark brown, colour pattern of tergites VI and VII U-shaped; sternites I – V translucent, sternites VI – VIII brownish along anterior margin.

Genitalia. Hypandrium narrowed distally with short upright tip, on both sides with elongate horizontal gonocoxal apodemes. Dorsal prolongations of hypandrium



Figs. 16-17. *Chelifera curvata* sp. nov.: 16. genitalia, lateral view; 17. cerci, dorsal view. **Figs. 18-19.** *Chelifera rhombicerca* sp. nov.: 18. genitalia, lateral view; 19. cerci, dorsal view. **Figs. 20-21.** *Chelifera stauderae* sp. nov.: 20. genitalia, lateral view; 21. cerci, dorsal view.

not detected. Phallus not visible due to heavy sclerotization and pigmentation of epandrium and cerci, ejaculatory apodeme strongly bent ventrally. Epandrium almost rectangular, only apicodorsal portion prolonged. Cercus irregularly shaped, in lateral view lower portion rounded with dorsal margin sinuous; upper distal margin almost straight. In dorsal view, inner margin of basal half of cercal lamellae run nearly parallel; beyond mid length inner margin almost circular with strong spines, and distally with further widening and further pair of spines.

Measurements. Body length 5.5 mm. Wing length 4.5 mm.

Derivatio nominis. Dedicated to Dipl.-Biol. A. Stauder a collaborator of the project. She is working on mayflies.

Relations. *Chelifera rhombicercas*, *C. stauderae* and *C. curvata* are close relatives. The shape of the epandrium, elongate gonocoxal apodemes, and the shape and pattern of the setae on the cerci clearly distinguish the males. Probably some of the females mentioned below belong to one of these species, however, we could not attribute them to males without any doubt.

Chelifera spec. 1

Material. 1♀ 24.09.1996; 1♀ 28.09.1996 (LFSS).

Description. Female. Head black, eyes black, shining reddish in light. Antenna and mouth parts yellow. Thorax entirely black. Wing with stigma. Legs pale yellow, 2 terminal tarsal segments brown. Tergites I – VI and basal half of tergite VII brown, tergite VIII brown.

Measurements. Body length 5.0-5.2 mm. Wing length 4.6-4.8 mm.

Chelifera spec. 2

Material. 1♀ 10.09.1996; 1♀ 11.09.1996; 1♀ 15.10.1996; 1♀ 16.10.1996; 1♀ 18.10.1996; 2♀ 02.11.1996; 1♀ 05.11.1996; 1♀ 16.10.1997 (LFSS).

Description. Female. Head black, eyes red, antenna and mouth parts yellow. Wing with stigma. Front legs entirely yellow, middle and hind legs yellow with tarsal segments 4 and 5 dark brown. Abdominal tergites dark brown, sternites translucent. Last abdominal segment uniformly black, with ventral hook-like appendage arising from basal half of last segment.

Measurements. Body length 5.1–6.3 mm. Wing length 4.3–6.3 mm.

Relations. The senior author noted similar construction of the female abdominal tip in some East African Hemerodromiinae of the genus *Drymodromia* Becker. Probably this is based on the different generic rank, an adaptation to some similar ecological demands (egg deposition habitat).

Chelifera spec. 3

Material. 1♀ 13.05.1997 (LFSS).

Description. Female. Head dark brown, eyes dark. Antenna and mouth parts yellow. Thorax laterally brown, dorsally with broad median dark brown streak all over thorax. Wing with stigma. Legs pale yellow, with 2 terminal tarsal segments brown. Tergites brown, abdominal sternites whitish. Tip of abdomen black.

Measurements. Body length 5.5 mm. Wing length 4.0 mm.

Chelifera spec. 4

Material. 1♀ 25.11.1997 (LFSS).

Description. Female. Head black, eyes black. Antenna and mouth parts yellow. Thorax uniformly black. Wing with stigma. Legs pale yellow, tarsal segments 4 and 5 brown. Tergites I – III brown, tergites IV – VIII with V-shaped white pattern in distal part of tergites, increasing in size caudally, abdominal sternites clear.

Measurements. Body length 4.3 mm. Wing length 4.0 mm.

Species incertae sedis

Chelifera accomodata Wagner & Leese sp. nov.

(Figs 22–23)

Material. Holotype 1♂ 05. 06.1997 (ZFMK).

Description. Male. The only specimen is in poor condition, so that some features were not explicitly observed. Head brown, antenna and mouth parts yellow. Thorax uniformly brown. No stigma. Legs yellow, middle and hind legs with 2 terminal tarsal segments blackish. Middle tibia ventrally with row of 13 long dark setae. Abdominal tergites brown, sternites translucent.

Genitalia. Brown, hypandrium elongate rectangular, no projecting apodemes, dorsal prolongations not observed. Epandrium L-shaped, setose, with one strong seta on distal inner end, and another medially along dorsal margin, visible only in inner view. Cercus evenly curved along dorsal margin, apex strongly attenuated forming small short tip with strong seta. Front ventral almost straight, lower margin slightly sinuous, distal margin short and straight. Inner view of cercus with 3 strong spines along distal margin, and long seta opposite median seta of epandrium.

Measurements. Body length 4.0 mm. Wing length 4.0 mm.

Derivatio nominis. The species fits (accommodates), however with some doubt, into the *C. rhombicercus* species group.

Relations. This species is probably a close relative of *Chelifera stauderae*, *C. rhombicercus*, and *C. curvata*, but readily distinguished by the shape of the epandrium and its two large inner setae.

Chelifera brevidigitata Wagner & Leese sp. nov.

(Figs 24–26)

Material. Holotype: 1♂ 16.11.1997 (ZFMK).

Description. Male. Head dark brown, mouth parts and antenna brownish yellow, terminal antennal segment darker. Thorax shining red brown. No colour pattern on thorax, specimen partly destroyed. Wing with brown stigma, veins intensively coloured. Legs orange yellow, segments 4 and 5 of middle and hind tarsi darker. Abdominal tergites brown.

Genitalia. Hypandrium elongate, slightly bent dorsally, dorsal prolongations not seen. Epandrium slightly bent, without prominent setae. Cercus with dorsal margin slightly bent, distally on inner side with irregular rows of short setae; front and lower margin almost straight. In dorsal view median portions of cercal lamellae slightly overlap, distally forming small circular incision.

Measurements. Body length 4.0 mm. Wing length 4.4 mm.

Derivatio nominis. Name is derived from the short ventral prolongation of the cerci.

Relations. The narrow hypandrium is superficially similar to *C. haeselbarthae*, however, body colouration and shape of remaining parts of the genitalia do not support this assumption.

Chelifera digitata Wagner & Leese sp. nov.

(Figs 27–29)

Material. Holotype: 1♂ 09.07.1997 (ZFMK); Paratype: 1♂ 18.06.1997 (NZSI).

Description. Male. Head brown, antenna and mouth parts pale yellow. Thorax pale brown. Mesonotum with pair of lateral brown streaks. Scutellum and metanotum brown. No stigma. Legs pale yellow, distal tarsal segments darker. Middle tibia in basal half with row of about 13 long dark setae. Abdominal tergites brown, remaining tergites and sternites clear.

Genitalia. Hypandrium short triangular, with 2 dorsal prolongations, postgonite strong and S-shaped, distal hypandrial process short and straight. Phallus upright, not fully extruded, distally with few short spines. Epandrium basally broad, distally thinner and strongly bent dorsally, tip with one long inner seta. Cercus roughly triangular, basal and distal margins almost straight, dor-

sal rim basally evenly bent, distally with deep incision, forming narrow dorsal prolongation with 5 strong inner setae; another single seta located on inner side near middle of distal margin.

Measurements. Body length 2.1–2.7 mm. Wing length 1.8–2.1 mm.

Derivatio nominis. Name is based on the dorsal prolongation of the cerci.

Relations. The species is unique in the possession of an almost median dorsal prolongation of the cerci with few strong setae, and the upright terminal portion of the epandrium, with a strong elongate seta.

***Chelifera haeselbarthae* Wagner & Leese sp. nov.**
(Figs 30–32)

Material. Holotype: 1♂ 11.05.1997 (ZFMK); 2♂ 17.05.1997; 1♂ 1♀ 23.05.1997; 1♀ 24.05.1997; 1♂ 25.05.1997; 1♂ 28.05.1997; 1♂ 2♀ 30.05.1997; ; 1♀ 01.06.1997; 2♂ 1♀ 02.06.1997; 2♂ 1♀ 03.06.1997; 1♀ 11.06.1997; 1♀ 22.06.1997; 1♀ 28.06.1997; 1♀ 06.10.1997. All males are paratypes and deposited at NZSI, NHMB, and LFSS.

Description. Head brown, antenna and mouth parts yellow. Thorax pale yellow. Mesonotum with pair of longitudinal brown streaks, basally narrow, distally increasing in width. Scutellum yellow, metanotum brown. Legs pale yellow, middle and hind tarsi with segments 4 and 5 brown. Wing without stigma. Abdominal tergites I – IV little pigmented, remaining tergites and sternites clear. Female with abdominal segments I to VI pigmented, remaining sclerites translucent.

Male Genitalia. Hypandrium elongate, slightly bent ending in dorsal tip. Postgonite broad, with small basal and larger caudal bulge. Phallus upright, not fully extruded, median portion covered by tuft of setae. Epandrium thin, sickle-shaped, with two elongate bristles on inner distal third. Cercus oval, with inner basal sclerite bearing 2 long setae; along dorsal margin with 1 or 2 irregular rows of setae, and along distal margin with row of 7 short strong setae.

Measurements. Body length ♂ 3.1–3.7 mm, ♀ 2.9–4.1 mm. Wing length ♂ 3.0–3.4 mm, ♀ 3.5–4.3 mm.

Derivatio nominis. Dedicated to Mrs Carola Haeselbarth, who strongly supported the field work.

Relations. The shape of the cerci, the elongate epandrium and the narrow hypandrium are specific. There is no evident relation to any presently known *Chelifera* in the Himalayas.

***Chelifera* spec. 5**

Material. 1♀ 09.10.1996; 1♀ 26.10.1997 (LFSS).

Description. Female. Head with antenna and mouth parts yellow. Thorax yellow brown, mesonotum with

pair of lateral dark streaks. Scutellum yellow brown, metanotum darker. Wing with elongate faint stigma. Legs light yellow, segments 4 and 5 of middle and hind tarsi blackish. Middle tibia without bristles. Abdominal sternites clear, tergites I – VII and basal half of tergite VII brown, tergite VIII yellow, tip of abdomen black.

Measurements. Body length 3.5 mm. Wing length 3.2 mm.

***Chelifera* spec. 6**

Material 1♀ 26.06.1997 (LFSS).

Description. Female. Head brown, eyes black. Antenna and mouth parts yellow. Thorax uniformly brown. Wing without stigma. Legs pale yellow, tarsal segment 4 and 5 of mid and hind legs light brown. Tergites brown, sternites translucent.

Measurements. Body length 4.0 mm. Wing length 4.6 mm.

Relations. The female species 5 and 6 could not be assigned to males without any doubt, consequently these two forms were left untreated.

Genus *Hemerodromia* Meigen, 1822

Type-species: *Tachydromia oratoria* Fallén (des. of RONDANI, 1856: Dipt. Ital. Prodromus 1: 148).

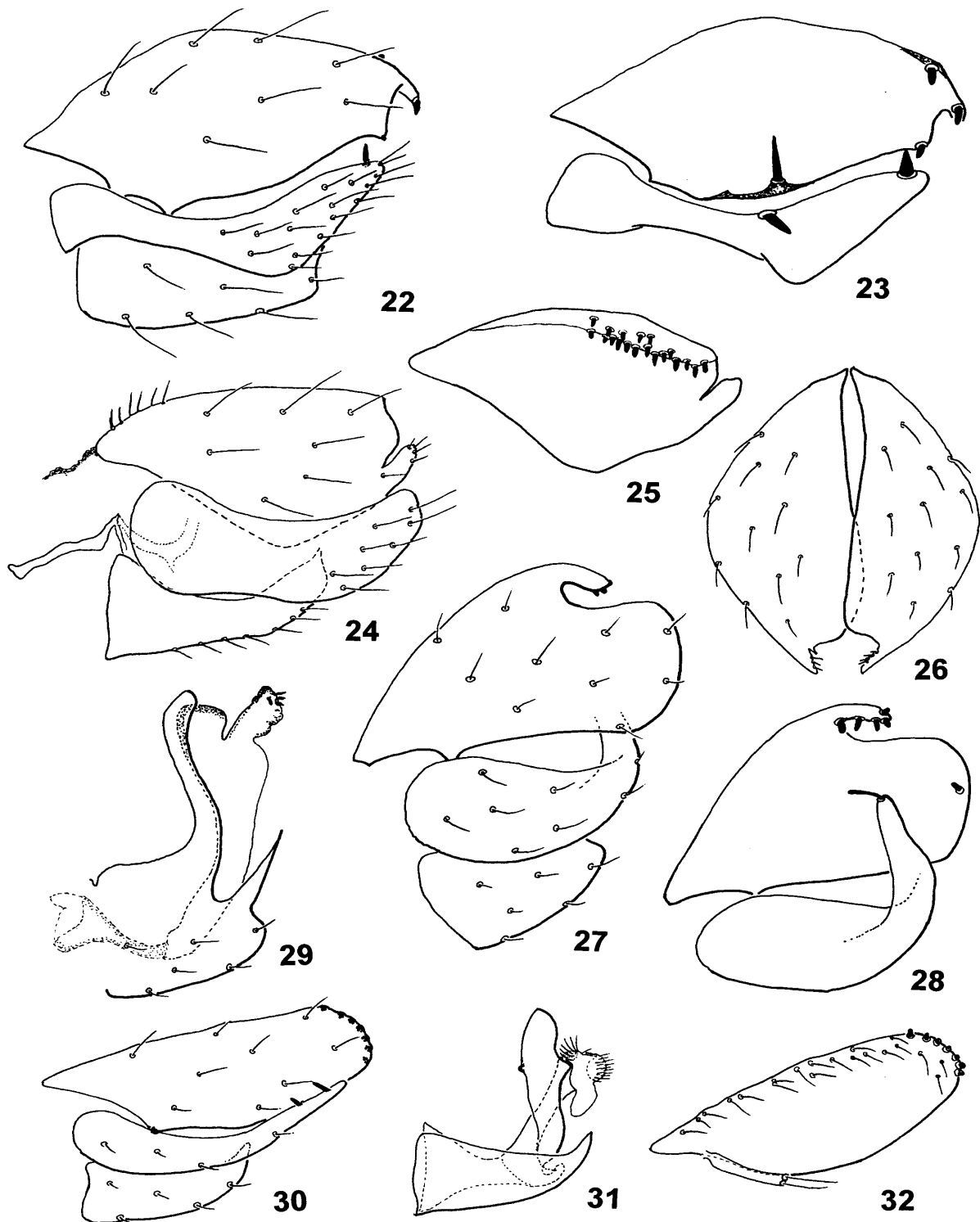
The genus in general contains small species with raptorial front legs, wing without discal cell, i.e. only one cross-vein between M_{1+2} and M_3 and no anal cell. SMITH (1965) described several new species of *Hemerodromia* from Nepal and reviewed Brunetti's taxa from the early Twentieth century. We borrowed specimens of all species available in the British Museum (Nat. Hist.) for comparison, and finally found that most species collected on the Naggar stream were new to science. Key to Himalayan species in Appendix II.

***Hemerodromia acutata* Grootaert, Yang & Saigusa, 2000** (Figs 33–35)

Material. 1♂ 23.07.1996 (LFSS).

Description. Male. Head brown, eyes reddish, mouthparts and antenna yellow. Thorax light brown; mesonotum with median brown streak, thin in front increasing in width towards light brown scutellum; metanotum dark brown. Legs yellow, distal tarsal segment (t_5) darker. Abdomen with segments I and VIII yellow, tergites II to VII brown.

Genitalia. Hypandrium elongate and narrow, in lateral view with upright distal tip; caudal end with brush of long setae. Ejaculatory apodeme forms an elongate thin clip, caudal tip thinner than median part. Epandrium rhomboid, distally with tuft of short setae, no epandrial lobe. Cercus elongate in lateral view, in dorsal view semicircular, inner margin with strong sub-apical seta, and 2 elongate apical setae.



Figs. 22-23. *Chelifera accomodata* sp. nov.: 22. genitalia, lateral view; 23. cercus and tip of epandrium, inner view. **Figs. 24-26.** *Chelifera brevidigitata* sp. nov.: 24. genitalia, lateral view; 25. cercus, inner view; 26. cerci, dorsal view. **Figs. 27-29.** *Chelifera digitata* sp. nov.: 27. genitalia, lateral view; 28. cercus and tip of epandrium, inner view; 29. hypandrium and phallus, lateral view. **Figs. 30-32.** *Chelifera haeselbarthae* sp. nov.: 30. genitalia lateral view; 31. hypandrium and phallus, lateral view; 32. cercus, inner view.

Measurements. Body length 3.2 mm. Wing length 2.8 mm.

Relations. GROOTAERT et al. (2000) described this species from China, (Yunnan province, Menglun). They reported close relations to *H. guangxiensis* YANG & YANG, from Yunnan and Guangxi. The latter species has a single longitudinal streak on the mesonotum, whereas *H. acutata* has two. Because specimens from the present study have only one streak, confusion about species identity remains and a re-study of holotypes is absolutely necessary.

***Hemerodromia chitaoides* Wagner & Leese, sp. nov.**
(Figs 36-38)

Material. Holotype: 1♂ 01.09.1996 (ZFMK). Paratypes: 1♂ 09.11.1996; 1♂ 18.11.1996; 1♂ 23.11.1996. (♂ deposited at NZSI, NHMB, and LFSS). Further material: 1♀ 28.08.1996; 1♀ 15.10.1996 (LFSS).

Description. Head dark brown, mouthparts and antenna yellow. Thorax yellow; pro-, meso-, and metanotum and scutellum with broad brown streak increasing in width caudally, scutellum and metanotum entirely brown. Legs yellow, distal tarsal segment (t_5) darker. Abdominal segment I yellow, tergites II to VII brown. Female sternite VII distally and terminal segments entirely brown.

Male Genitalia. Dark brown. Hypandrium sickle-shaped, slightly bent upwards, distally thinner. Phallus sclerites faintly pigmented, straight. Epandrium approximately triangular, with fringe of setae along lower distal margin, inner epandrial lobe small with strong sub-apical hook on the inner side. Cercus elongate triangular in lateral view with a pair of inner apical strong setae, in dorsal view medially open semicircular, basally wide, and distally with 3 pairs of inner tips converging medially.

Measurements. Body length ♂ 2.9-3.5 mm, ♀ 3.5 mm. Wing length ♂ 2.6-2.9 mm, ♀ 2.7-2.8 mm.

Derivatio nominis. Similar to *Hemerodromia chita* Smith

Relations. Superficially this species is similar to *H. chita* Smith, 1965. Both species share an inner epandrial lobe, but the general shape of this lobe, the number of setae and a prominent ventral hook clearly distinguishes this new species. The epandrium is shorter and stouter in the new species and the cerci are upright.

***Hemerodromia elongatiodes* Wagner & Leese, sp. nov.** (Figs 39-41)

Material. Holotype: 1♂ 26.07.1996 (ZFMK).

Description. Male. Head brown, eye reddish, mouthparts and antenna yellow. Thorax light brown; mesonotum with light brown median streak; scutellum light brown, metanotum dark brown. Front legs lost, middle and hind legs light brown, distal tarsal segment (t_5)

darker. Abdomen with segments I and VIII yellow, tergites II to VII brown.

Genitalia. Hypandrium similar to *Chelifera*; short and stout with 2 pairs of dorsal prolongations, basal projection elongate and boot shaped, distal projection short and serrate. Epandrium long and narrow, slightly bent upwards, with three sub-apical inner prominent spines. Cercus elongate rectangular with 5 or 6 short strong spines along inner distal margin.

Measurements. Body length 2.8 mm. Wing length 2.3 mm.

Derivatio nominis. Name is based on the elongate epandrium.

Relations. The generic assignment of this species is uncertain. On the basis of the wing venation (no discal and anal cell), it is a member of *Hemerodromia*. However, on the basis of male genitalia, and in particular two pairs of dorsal prolongations on the hypandrium is characteristic of *Chelifera* Macquart. There are no similarities with taxa already described from this region.

***Hemerodromia rhomboides* Wagner & Leese, sp. nov.**
(Figs 42-44)

Material. Holotype: 1♂ 25.07.1997 (ZFMK).

Description. Male. Head brown, mouthparts and antenna yellow. Pronotum light brown, mesonotum basally with 2 lateral brown streaks that join right in front of scutellum to form U-shaped pattern; scutellum and metanotum brown. Legs entirely yellow. Abdomen with segments I and VIII yellow, tergites II to VII brown.

Male Genitalia. Hypandrium semicircular, almost bare; encloses solid straight and distally bilobed phallus. Epandrium rhomboid with fringe of long setae along ventral and distal sides. Cercus approximately triangular in lateral view, with basal U-shaped incision; inner side with dorsal field of short strong setae, and few longer setae caudally.

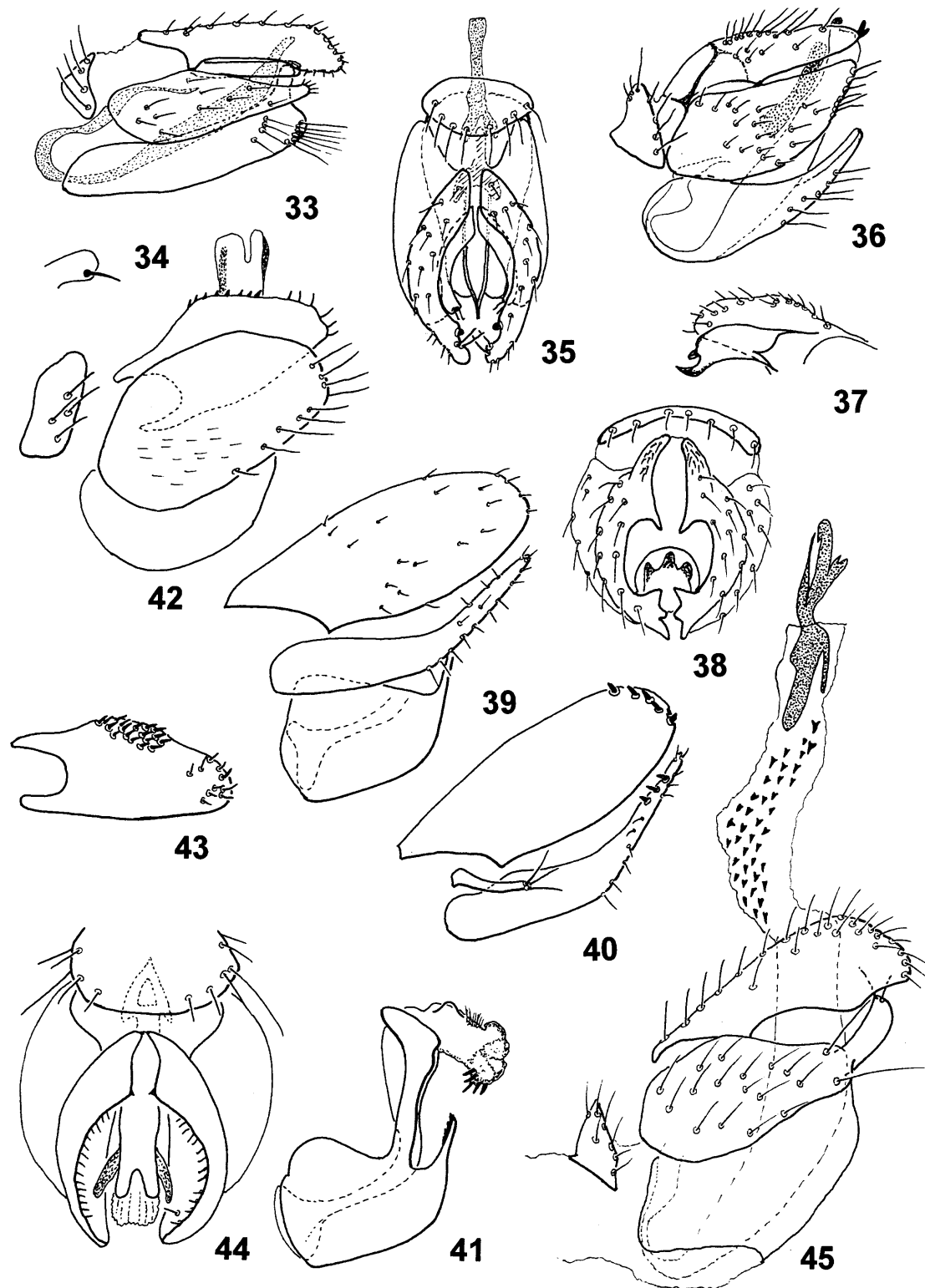
Measurements. Body length 3.3 mm. Wing length 3.0 mm.

Derivatio nominis. Name is derived from the rhomboid shape of the epandrium.

Relations. This species is readily distinguished from its congeners by the shape of the genitalia and the cerci in particular.

***Hemerodromia spinosa* Wagner & Leese sp. nov.**
(Fig. 44)

Material. Holotype: 1♂ 05.05.1997 (ZFMK); 1♀ 22.05.1997 (LFSS); paratype: 1♂ 30.05.1997 (NZSI).



Figs. 33-35. *Hemerodromia acutata* Grootaert, Yang & Saigusa: 33. genitalia, lateral view; 34. tip of cercus, inner view with seta; 35. genitalia, dorsal view. **Figs. 36-38.** *Hemerodromia chitaioides* sp. nov.: 36. genitalia, lateral view; 37. tip of epandrium and epandrial lobe, inner view; 38. genitalia, dorsal view. **Figs. 39-41.** *Hemerodromia elongatoides* sp. nov.: 39. genitalia, lateral view; 40. epandrium and cercus, inner view; 41. hypandrium and phallus, lateral view. **Figs. 42-44.** *Hemerodromia rhomboides* sp. nov.: 42. genitalia, lateral view; 43. cercus, inner view; 44. genitalia, dorsal view. **Fig. 45.** *Hemerodromia spinosa* sp. nov., genitalia, lateral view.

Description. Head dark brown, eye reddish, mouthparts and antenna yellow. Thorax orange; pro- and mesonotum with central blackish broad streak, scutellum and metanotum entirely black. Legs orange-yellow. Male abdomen with segments I yellow, tergites II to VI brown, genitalia black. Female abdomen with tergite VII yellowish, segment VIII and genitalia dark.

Male Genitalia. Hypandrium rectangular, phallus elongate thick, distally with very long extruded slightly sclerotized sac, basally with numerous spines and distally with irregularly shaped sclerite. Epandrium consists of elongate oval base and short bare distal portion with 2 distal setae. Cercus wider distally, basal portion only half as wide as distal part; dorsal margin with fringe of setulae.

Measurements. Body length ♂ 3.4-3.5 mm, ♀ 4.0 mm. Wing length: ♂ 2.8-3.0 mm, ♀ 3.0 mm.

Derivatio nominis. Derived from the numerous spines on the phallic sheath.

Relations. The shape of the cerci and the distal attenuated elongation of the epandrium are distinctive features of this species.

Hemerodromia spec. 1

Material. 1♀ 20.10.1997 (LFSS).

This female differs from other specimens by the overall coloration. Mesonotum pale brown in proximal two-thirds, darker in caudal third. Abdomen with segment VII and distal segments brown.

Measurements. Body length 3.0 mm. Wing length 2.8 mm.

Hemerodromia spec. 2

Material. 1♀ 12.09.1996 (LFSS).

This specimen differs from all species described by entirely yellow thorax, including scutellum and metanotum. Abdominal tergite I yellow, tergites II-VII brown, sternite VII brown.

Measurements. Body length 3.5 mm. Wing length 3.3 mm.

Comment. Although by means of the colour pattern these two females differ from all congeners collected at this site, no new species were named because males have not been associated.

Subfamily Trichopezinae

Genus *Heleodromia* Haliday, 1833

Type-species: *H. immaculata* Haliday (des. of CURTIS 1834: Brit. Ent. 11: pl. 513).

Heleodromia includes species with slightly elongate mouthparts, front legs not raptorial, and wings with a simple cubital vein. Males share characteristically bean-shaped genitalia, female abdominal tergite VII with

conspicuous fringe of long fine setae and tergite X with strong spines. Key to Himalayan species in Appendix III. The holotype of *H. obscura* (Brunetti) was not examined.

Heleodromia rami Wagner & Leese sp. nov.

(Figs 46-47)

Material. Holotype: 1♂, 09.04.1997 (ZFMK).

Description. Male. Body light brown, thorax glossy metallic. Head with 6-7 postocular bristles and fine setae on ventral part of head. Mesonotum with at least 1 ac and 4 dc. Legs brown, fore femur distally and fore tibia basally lighter. Abdomen with eight segments, tergite VIII in lateral view with elongate dorsal prolongation, tip blunt in dorsal view.

Genitalia. Bean shaped. Hypopygium elongate. Dorsal part of the genitalia distally wider and higher, with fringe of elongate fine setae along frontal rise. Posteriorly lies short thin prolongation with 1 long bristle and broad prolongation with dorsal fringe of short setae. Within genital chamber lies upright and distally Y-shaped ejaculatory apodeme.

Measurements. Body length 3.8 mm. Wing length 3.2 mm.

Derivatio nominis. Dedicated to the late Mr. Sita RAM.

Relations. About one dozen Palearctic taxa of *Heleodromia* have been described and figured (WAGNER 1985, NIESIOLOWSKI 1986, SAIGUSA 1963), and recently two species were recorded from Baltic amber (HOFFEINS et al. 1998; WAGNER et al. 2000). The only species known from the Himalayas so far are *H. obscura* Brunetti, 1913 (Simla, Himachal – holotype not examined), *H. hilo* Smith, 1965 (Nepal, Taplejung district), and *H. ausobskyi* Wagner, 1983 (Nepal, Ilam district). *Heleodromia rami* is distinguished by the prominent prolongation of tergite VIII, by the short and stout hypopygium, and the shape of the dorsal appendages of the genitalia.

Heleodromia spp.

Material. 1♀ 18.12.1996; 1♀ 29.11.1996 (LFSS).

Both females differ in size and body coloration, and belong to different species. Probably they are even not conspecific with the above male. Wings without stigma. Mesonotum with at least 1 ac and 4 dc.

Measurements. Body length 2.8 / 4 mm. Wing length 3.4 / 5.8 mm.

Subfamily Clinocerinae

Genus *Clinocera* Meigen, 1803

Type-species: *C. nigra* Meigen, 1804 (subsequent monotypy)

Clinocera was the most diverse genus in the collection of aquatic Empididae. Adult males are characterized by lower margin of face without notch, apical filament of phallus non-articulated, and R_1 lacking macrotrichia.

The species belong to the *Clinocera lineata* or the *C. nigra*-group (SINCLAIR 1995) and are characterized by a remarkably large and within the group strikingly variable surstylus, whereas the clasping cercus is more or less simple, and upright. The phallus possesses a short apical filament. Transition between phallus and filament distinguishes both groups. Wing genotypically, light brown translucent without stigma. All species have almost identical numbers of setae on head and thorax: 1 oc, 5-8 poc, 1 pb, 2-3 ac, and 5 dc; scutellum with 1 pair of bristles. The main specific features are size and shape of male genital structures, in particular that of the surstylus. Key to Himalayan species in Appendix IV.

Clinocera lineata group

Species of this group are characterised by a thin, elongate and upright clasping cercus, the distal end of the phallus increasing in width with a clear borderline between phallus and flagellum.

Clinocera cuspidata Wagner & Leese sp. nov.

(Figs 48-49)

Material. Holotype: 1♂ 15. 11.1997 (ZFMK); paratype: 1♂ 01. 03.1997 (NZSI).

Description. Male. Head black. Thorax dark brown. Legs light brown. Front femur with central row of 4 bristles, length $\frac{1}{4}$ femur diameter, and central row of 5 bristles, approx. $\frac{1}{3}$ femur diameter.

Genitalia. Short triangular hypandrium. Phallus strong, slightly bent, tip distinctly above dorsal margin of surstylus, flagellum short, basally wide. Epandrium quadrate. Clasping cercus simple, upright, tip spearhead-shaped; along inner side with proximo-dorsal row of short strong spines. Surstylus large, basally and medially wide, with short less prominent tip, and along distal margin with fringe of long fine setae. Subepandrial sclerite Y-shaped with elongate proximal, and short median prolongations. Cercal plates elongate oval with row of long setae.

Measurements. Body length 3.1-3.6 mm. Wing length 3.2-3.5 mm.

Derivatio nominis. Derived from the spearhead-shaped clasping cercus.

Clinocera longicercus Wagner & Leese sp. nov.

(Figs 50-51)

Material. Holotype: 1♂ 24. 11.1997 (ZFMK); paratypes: 1♂ 27. 12.1996; 1♂ 05. 01.1997; 1♂ 19. 01.1997; 1♂ 23. 01.1997; 1♂ 1♀ 05. 02.1997; 1♂ 27. 02.1997; 1♂ 21. 11.1997; 1♂ 27.

11.1997; 1♂ 11. 12.1997. (3 paratypes + 1♀ (NHMB); 3 paratypes NZSI and LFSS.

Description. Male. Head brown-black, 1 oc, and about 7 uniserial poc. Thorax dark brown, shining. Legs brown, ventrally yellow-brown. Front femur with central row of 8-10 short and lateral row of 6-7 longer bristles.

Genitalia. Small triangular hypandrium. Phallus thick, distally increasing in diameter; tip at dorsal margin of clasping cercus, flagellum half length of basal portion. Epandrium quadrate, dorsal edge convex. Clasping cercus simple, upright and thin; inner face with few setae and some strong spines at tip. Surstylus large, basally and medially wide, with short thin tip, and fringe of fine setae along caudal margin. Subepandrial sclerite Y-shaped but with three tips, one towards clasping cercus, two towards surstylus. Cercal plate elongate thin with row of long setae.

Measurements. Body length ♂ 2.9-3.3 mm, ♀ 3.0 mm. Wing length ♂ 2.9-3.4 mm, ♀ 2.9 mm.

Derivatio nominis. Name derived from the upright, slim, elongate clasping cercus.

Clinocera marginesetosa Wagner & Leese sp. nov.

(Figs 52-53)

Material. Holotype: 1♂ 01.03.1997 (ZFMK); paratype: 1♂ 26.10.1997 (NZSI).

Description. Male. Head black, 1 oc, and 6-8 uniserial poc. Thorax dark rusty-brown. Legs light brown, coxae and femura laterally yellowish. Front femur with central row of 7 and lateral row of 5 bristles, length $\frac{1}{2}$ of femur diameter.

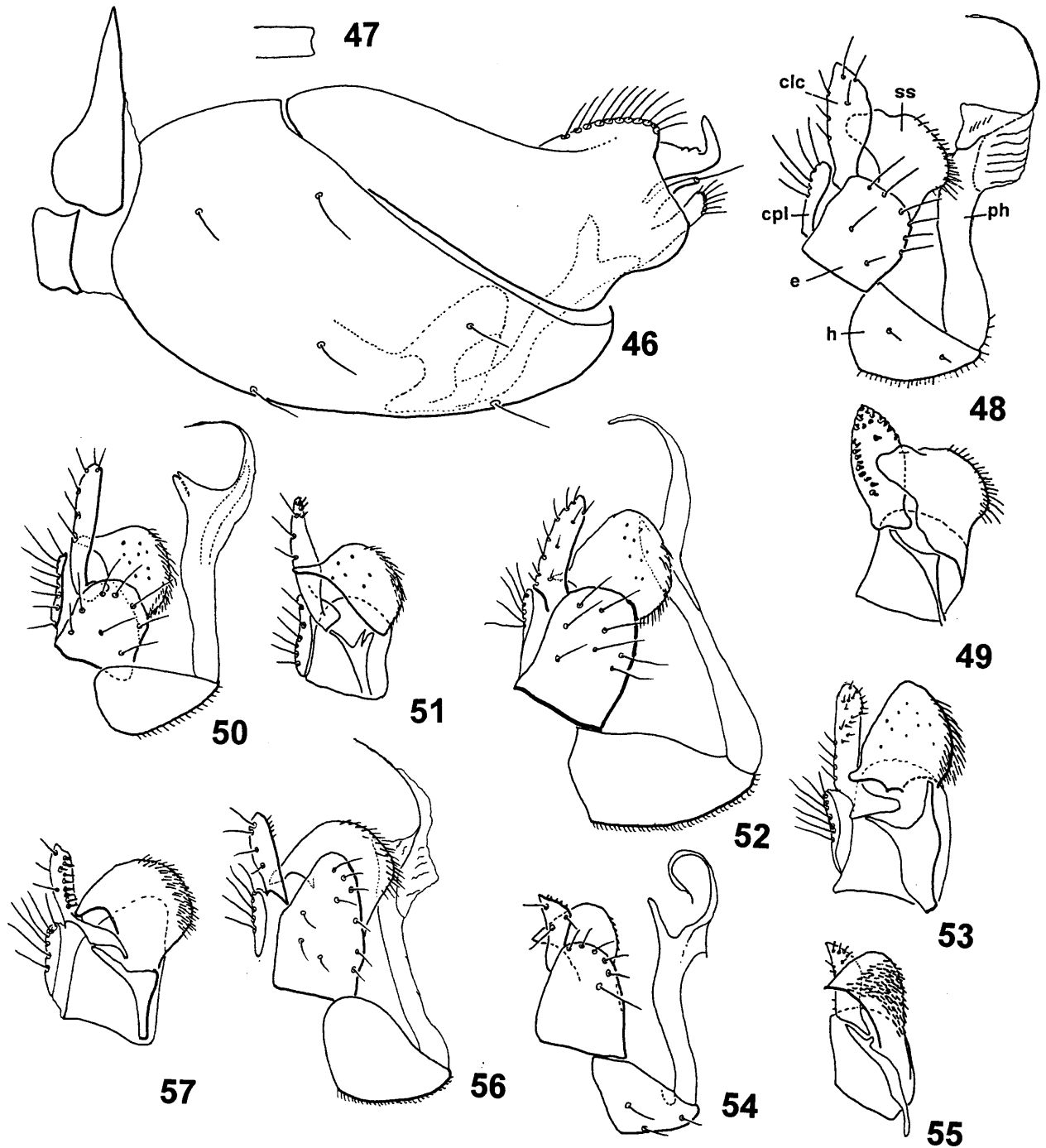
Genitalia. Elongate rhomboid hypandrium. Phallus thin, tip distally of surstylus dorsal margin, flagellum basally wide, slightly bent upward. Epandrium upright, rectangular with rounded edges. Cercal plate elongate with row of long fine setae. Clasping cercus simple, upright in lateral view; inner view basally with short strong caudal appendage. Surstylus very large almost oval, with short proximal tip and with setae along caudal margin. Subepandrial sclerite clearly Y-shaped, with arms of subequal length. Cercal plate thin, elongate.

Measurements. Body length 3.5-3.6 mm. Wing length 3.4-3.8 mm.

Derivatio nominis. Derived from the setose distal margin of the surstylus.

Clinocera minutissima Vaillant (Figs 54-55)

Material. 1♀ 06. 09.1996; 1♂ 15.10.1996; 1♀ 23. 10.1996; 2♀ 10. 11.1996; 1♀ 13. 11.1996; 1♀ 24. 01.1997; 1♂ 21.04.1997; 1♂ 09.11.1997; 1♂ 17.11.1997. (all LFSS)



Figs. 46-47. *Heleodromia rami* sp. nov.: **46.** genitalia, lateral view; **47.** tip of tergite VIII, dorsal view. **Figs. 48-49.** *Clinocera cuspidata* sp. nov.: **48.** genitalia, lateral view; **49.** cpl, e, clc and ss, inner view. **Figs. 50-51.** *Clinocera longicercus* sp. nov.: **50.** genitalia, lateral view; **51.** cpl, e, clc and ss, inner view. **Figs. 52-53.** *Clinocera marginesetosa* sp. nov.: **52.** genitalia, lateral view; **53.** cpl, e, clc and ss, inner view. **Figs. 54-55.** *Clinocera minutissima* Vaillant: **54.** genitalia, lateral view; **55.** e, clc and ss, inner view. **Figs. 56-57.** *Clinocera stackelbergi* Vaillant: **56.** genitalia, lateral view; **57.** cpl, e, clc and ss, inner view. (clc-clasping cercus; cpl-cercal plate; e-epandrium; h-hypandrium; ph-phallus; ss-surstylus)

Description. Head blackish, eyes blackish, 1 oc, and 5-8 uniserial poc. Thorax dark brown, lighter in ♀. Legs yellow brown, coxae dorsally brown, laterally yellow. Front femur with 7-9 long fine setae in two rows ventrally. Empodium, pulvilli, claws subequal in length, and 0.5 times the length of tarsal segment 5. Abdomen brown.

Male genitalia. Small, hypandrium rhomboid. Phallus strong, slightly bent with elongate front upright tooth, and distal flagellum. Epandrium rounded triangular, clasping cercus axe-shaped with several stronger bristles along inner dorsal margin. Surstylus large, distally wider, dorsally rounded, with sharp frontal tip, setose on inner central area. Subepandrial sclerite slightly bent with short subapical tip. Cercal plate small.

Measurements. Body length ♂ 2.7-2.8 mm, ♀ 2.5-3.3 mm. Wing length ♂ 2.6-2.7 mm, ♀ 2.6-3.3 mm.

***Clinocera stackelbergi* Vaillant (Figs 56-57)**

Material. 1♂ 17. 11.1997(LFSS).

Description. Male. Head dark, eye black, 1 oc, and 6 uniserial poc.

Thorax dark brown. Legs brown, coxae and femura laterally lighter. Front femur with central row of 7-8 and lateral row of 5 bristles, 1/3 as long femur diameter.

Genitalia. Small, hypandrium triangular. Phallus thin, tip below dorsal margin of surstylus, flagellum slightly bent upward, basal part very wide. Epandrium upright, rhomboid with rounded edges. Cercal plate elongate oval. Clasping cercus straight in lateral view; in inner view with elongate caudal appendage. Surstylus very large, increasing in width medially, with sharp proximal tip and setae along the upper distal margin. Subepandrial sclerite slightly bent with strong medial tip towards the surstylus, and thin elongate tip towards the clasping cercus.

Measurements. Body length 3.5 mm. Wing length 3.2 mm.

***Clinocera nigra* group**

This species group is distinguished by its phallus lacking almost any transition towards the flagellum.

***Clinocera lunata* Wagner & Leese sp. nov.**
(Figs 58-59)

Material. Holotype: 1♂ 16. 11.1997 (ZFMK); paratype: 1♂ 05.12.1997 (NZSI).

Further material. 1♀ 21. 01.1997; 1♀ 03. 06.1997; 1♀ 29.11.1997 (LFSS).

Description. Male. Head blackish, 1 oc, and 5-6 uniserial poc. Thorax black. Pronotum with 1 pb, mesonotum black, with 2 ac, and 5 dc. Scutellum with 1 pair of bris-

gles. Legs black. Front femur with central row of 7 bristles 1/3 femur diameter, and central row of 6 bristles, length 1/2 femur diameter.

Genitalia. Elongate hypandrium. Phallus elongate thick, almost straight; tip distinctly above dorsal margin of surstylus, flagellum very short. Epandrium upright, rhomboid. Clasping cercus simple, distally rectangular, on inner side with dorsal area of strong spines, basally setose. Surstylus large sickle-shaped, widest medially, with prominent proximal tip, along distal margin with fringe of long fine setae. Subepandrial sclerite upright with very short prolongation towards surstylus and stronger part towards clasping cercus. Cercal plates elongate oval with row of long setae.

Female similar to male, coloration lighter and front femur without long bristles.

Measurements. Body length ♂ 4.3-5.2 mm, ♀ 3.7-4.6 mm. Wing length ♂ 4.1-4.5 mm, ♀ 4.0-4.4 mm.

Derivatio nominis. Derived from the sickle-shaped, large surstylus.

***Clinocera lunatoides* Wagner & Leese sp. nov.**
(Figs 60-61)

Material. Holotype: 1♂ 17.12.1997 (ZFMK); 1♀ 13.12.1997 (LFSS).

Description. Head, thorax and legs dark brown. Legs brown. Front femur with biserial bristles, 5 laterals longer than 7 inner bristles. Tarsal segment 5, empodium, pulvilli and claws elongate.

Male Genitalia. Rhomboid hypandrium. Phallus thick, straight; tip at dorsal margin of clasping cercus, flagellum short, thin. Epandrium rhomboid. Clasping cercus rounded rectangular; dorsally on inner face with loose area of strong spines. Surstylus elongate, sickle-shaped, with fringe of setae along caudal margin. Subepandrial sclerite elongate, straight with very short side arms. Cercal plates elongate oval with row of long setae.

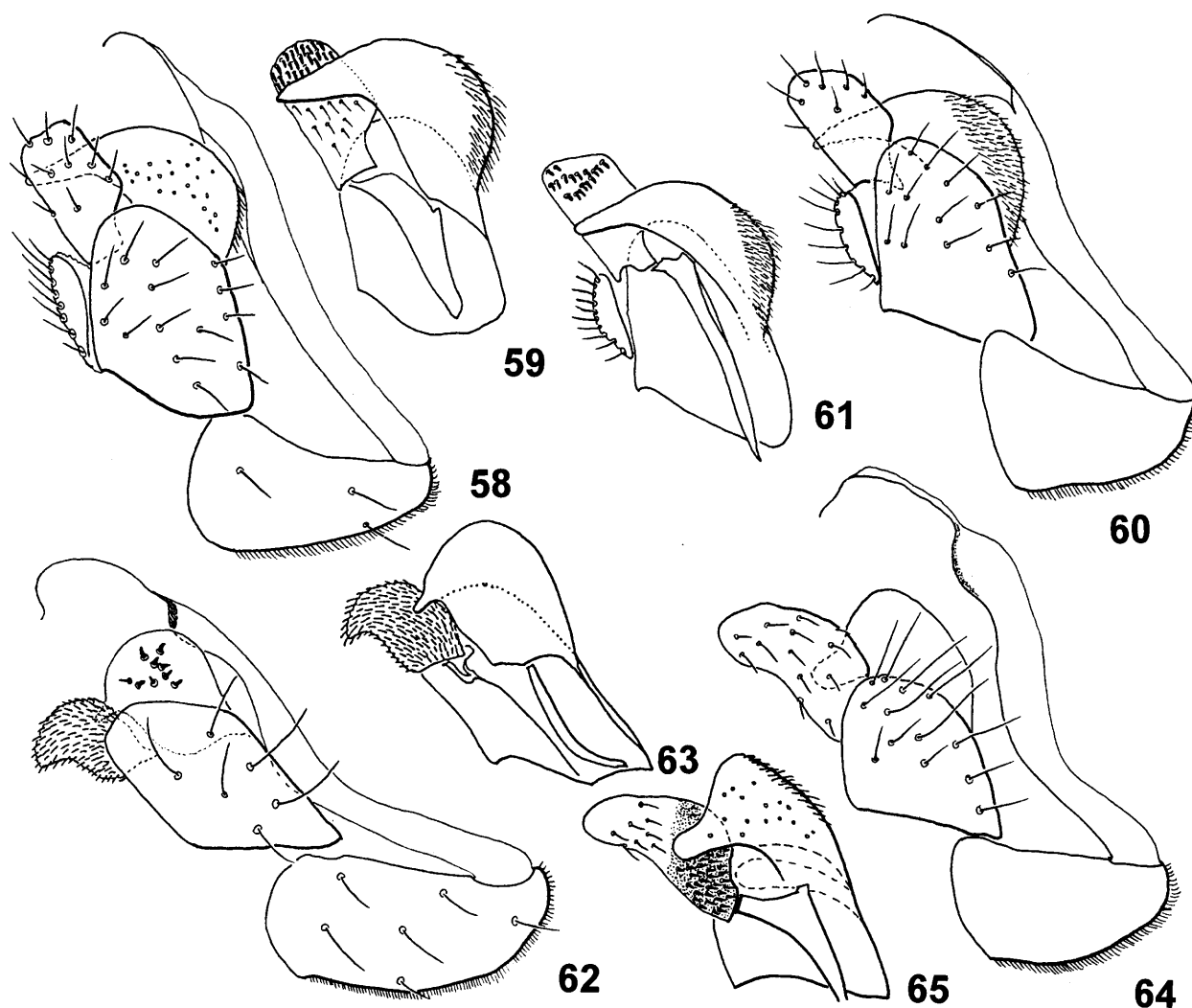
Measurements. Body length ♂ 4.2 mm, ♀ 4.4 mm. Wing length ♂ 4.0 mm, ♀ 4.8 mm.

Derivatio nominis. Derived from the sickle-shaped surstylus, which is similar to *C. lunata*.

***Clinocera setosa* Wagner & Leese sp. nov.**
(Figs 62-63)

Material. Holotype: 1♂ 11.12.1996 (ZFMK); paratypes: 1♂ 05.10.1997 (NHMB); 1♂ 29.10.1997 (NZSI).

Description. Male. Head black. Face not swollen. Thorax dark brown. Legs brown, coxa and femur laterally lighter brown, not yellowish. Front femur with central row of 8-9 and peripheral row of 7 bristles, length approx. 1/2 femur diameter.



Figs. 58-59. *Clinocera lunata* sp. nov.: 58. genitalia, lateral view; 59. e, clc and ss, inner view. **Figs. 60-61.** *Clinocera lunatoides* sp. nov.: 60. genitalia, lateral view; 61. cpl, e, clc and ss, inner view. **Figs. 62-63.** *Clinocera setosa* sp. nov.: 62. genitalia, lateral view; 63. e, clc and ss, inner view. **Figs. 64-65.** *Clinocera sinclairi* sp. nov.: 64. genitalia, lateral view; 65. e, clc and ss, inner view.

Genitalia. Elongate hypandrium. Phallus elongate thin, and medially curved; tip distinctly above dorsal margin of surstylus, flagellum short and thin. Epandrium upright, rhomboid. Claspings cercus simple, setose on both sides, with short proximal tip. Surstylus large, with short 'nose' at upper proximal end, and with group of about 10 short setae over the medio-dorsal area on outer face, inner face probably without setae. Subepandrial sclerite Y-shaped, with frontal arm thin and the caudal arm strong. Cercal plate elongate small.

Measurements. Body length 3.3-3.5 mm. Wing length 3.2-3.4 mm.

Derivatio nominis. Derived from the setose claspings cercus.

***Clinocera sinclairi* Wagner & Leese sp. nov.**
(Figs 64-65)

Material. Holotype: 1♂ 04.03.1997 (ZFMK); paratypes: 1♂ 22.08.1996; 1♂ 17.11.1996; 1♂ 07.12.1997 (NZSI, NHMB, LFSS).

Description. Male. Head dark, 1 oc, 6 uniserial poc. Thorax brown. Legs light brown, coxae laterally yellowish. Front femur with 8-10 strong setae in two rows ventrally. Empodium, pulvilli, and claws subequal in length, and almost as long as tarsal segment 5. Abdomen brown.

Genitalia. Large, with elongate hypandrium, pubescence along ventral and hind margin. Phallus bent near base with short flagellum. Epandrium rhomboid, clasp-

ing cercus slightly bent with thin base, and almost straight front side, widest medially, distally thinner, rounded. In the basal third on inner side with several strong bristles, and darkened in basal half. Surstylus large, with prominent proximal 'nose'; caudal side with setae along upper distal margin. Subepandrial sclerite unevenly Y-shaped, the front end towards cercus wider and longer than end connected with surstylus. Cercal plate small elongate.

Measurements. Body length 3.5-4.0 mm. Wing length 3.4-3.8 mm.

Derivatio nominis. Dedicated to B. J. Sinclair a renowned Canadian entomologist with excellent publications on Empididae worldwide, now living in Germany.

Unplaced females

The following specimens could not be assigned to any of the above species.

Clinocera spec. 1

Material. 1♀ 28.08.1996; 1♀ 07. 03.1997; 1♀ 09.11.1997 (LFSS).

Description. Female. Head blackish, 1 oc, and 5-6 uniserial poc. Thorax dark brown, mesonotum lighter. Legs dorsally brown, ventrally yellow. Wing genotypical, opaque, without stigma.

Measurements. Body length 3.5-3.8 mm. Wing length 3.7-3.8 mm.

Clinocera spec. 2

Material. 1♀ 21. 02.1997 (LFSS).

Description. Female. Head blackish, 1 pair of oc, and approximately 7 poc. Thorax dark brown. Pronotum with 1 pb, mesonotum black, with at least 3 ac, and 5 dc. Scutellum with 1 pair of bristles. Legs orange-brown. Front femur without bristles. Wing genotypical, opaque, with elongate stigma.

Measurements. Body length 4.9 mm. Wing length 4.8 mm.

Relations. After the generic revision of the Clinocerinae, the genus *Clinocera* now contains six species groups, including the former subgenus *Hydrodromia* Macquart, 1835 (SINCLAIR 1995). Some species mentioned above appear to be close to the *C. lineata*-group, which contains species from the Oriental and southern Palearctic regions, and others have evident relations to the *C. nigra*-group, concerning the shape of the phallus in particular. Two further species from China (Zhejiang province, Mount Gutian) with a similar set of features, *Clinocera sinensis* and *C. wui*, (YANG & YANG 1995a) also are close relatives.

Clinocera cuspidata, *longicercus*, *minutissima*, *marginasetosa* and *stackelbergi* belong to the *C. lineata*-

group (SINCLAIR 1995) based on the thin, elongate and upright clasping cercus (clc) with the distal end of the phallus increasing in width and a clear borderline between phallus and flagellum. In this group, *C. stackelbergi*, *marginasetosa*, and *longicercus* are close relatives (simple upright setose clc), as well as *C. minutissima* and *C. cuspidata* (clc slightly bent). *Clinocera sinclairi*, *setosa*, *lunata* and *lunatoides* are members of the *C. nigra*-group (SINCLAIR 1995). In this group *C. lunata* and *C. lunatoides* (straight upright clc) are close relatives as well as *C. sinclairi* and *C. setosa* (clc slightly bent). The Chinese species were not taken into account.

Genus *Dolichocephala* Macquart, 1823

Type-species: *D. maculata* Macquart (by monotypy = *Tachydromia irrorata* Fallén)

Dolichocephala is characterized by the position of attachment of the head, presence of a small clypeus, and an extension of the subepandrial sclerite beyond the base of the clasping cercus. Adults are often brown, wing infuscated with pattern of translucent spots.

Dolichocephala panesari Wagner & Leese sp. nov. (Figs 66-67)

Material. Holotype: 1♂, India: 10.06.1996, Nishalla Nalla (stream) leg. Panesar [slide mounted, ZFMK].

Description. Male. Body brown. Head with row of 5 poc dorsally and additional white setae along eyes. Wing without stigma, opaque with 8 circular or oval translucent spots. Mesonotum with 2 ac and 5 dc; bristles of scutellum missing. Legs yellow brown. Abdomen brown.

Genitalia. Hypandrium short triangular with few setae, phallus typical for genus distally with two spines. Epan-drium with small hook-shaped surstylus, without setae. Clasping cercus elongate, slightly bent anteriorly (Fig. 66), with 2 setae at tip.

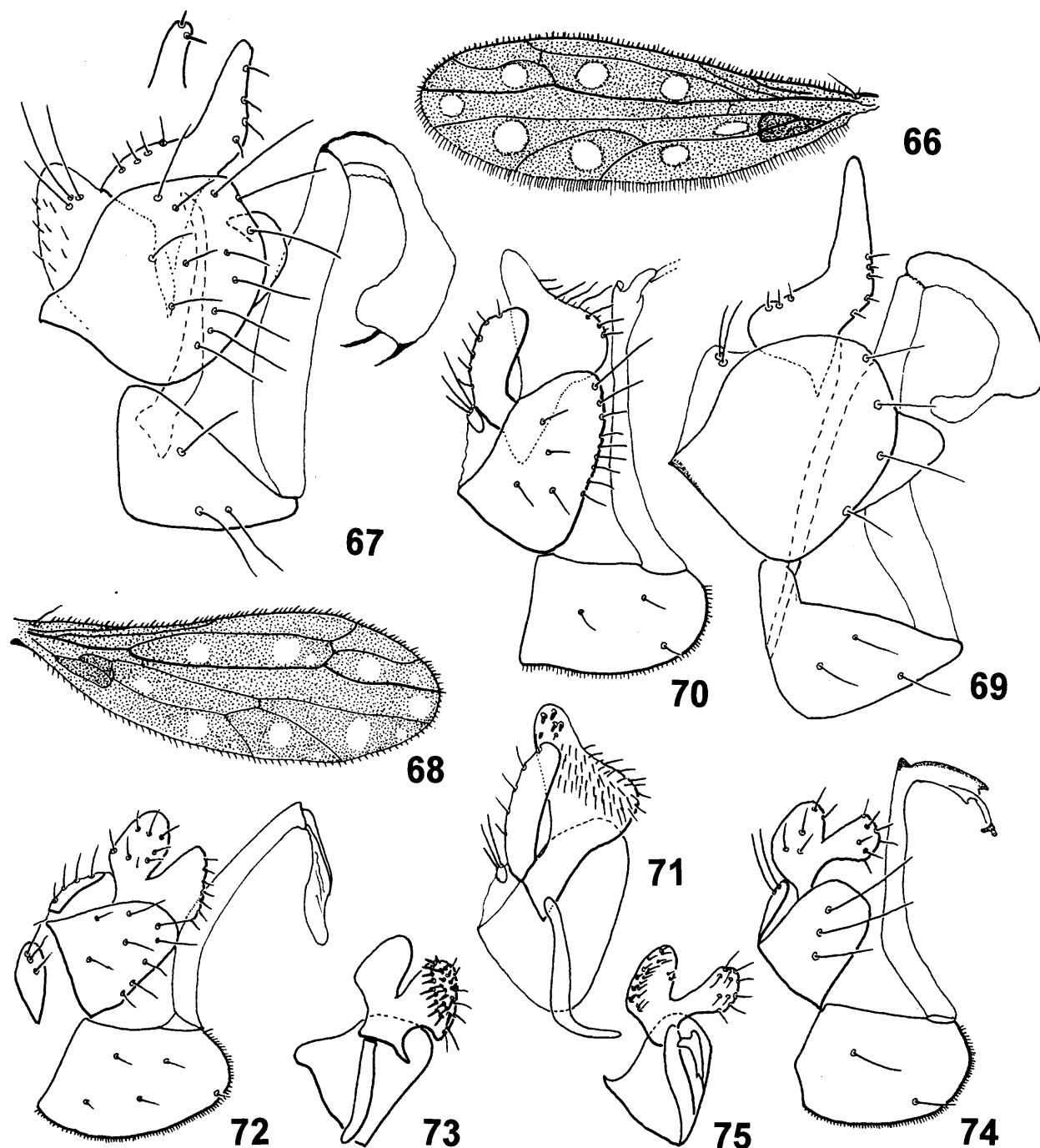
Measurements. Body length 3.0 mm. Wing length 2.1 mm.

Derivatio nominis. Dedicated to A. R. Panesar, the collector of the species and initiator of the study on a Himalayan mountain stream.

Dolichocephala rotundinota Wagner & Leese sp. nov. (Figs 68-69)

Material. Holotype: 1♂ 05.10.1996 (ZFMK); further material: 1♀ 15.09.1996; 1♀ 14.10.1996; 1♀ 15.10.1996; 1♀ 25.10.1996; 1♀ 13.11.1996; 1♀ 01.03.1997; 1♀ 05.05.1997; 1♀ 05.06.1997; 1♀ 16.06.1997; 1♀ 05.11.1997 (all LFSS).

Description. Head dark brown, eye blackish. Thorax brown, scutellum dark brown. Antenna and mouth parts brown. Legs light brown, fore coxa yellow, mid and hind coxae light brown. Wing without stigma, opaque with eight large and five very small translucent spots. Mesonotum with 2 ac, 5 dc. Legs yellow. Abdomen brown.



Figs. 66-67. *Dolichocephala panesari* sp. nov.: 66. genitalia, lateral view; 67. wing. **Figs. 68-69.** *Dolichocephala rotundinota* sp. nov.: 68. genitalia, lateral view; 69. wing. **Figs. 70-71.** *Roederiodes bilobatus* sp. nov.: 70. genitalia, lateral view; 71. cpl, e, and clc, inner view. **Figs. 72-73.** *Roederiodes naggarens* sp. nov.: 72. genitalia, lateral view; 73. e and clc, inner view. **Figs. 74-75.** *Roederiodes schwoerbeli* sp. nov.: 74. genitalia, lateral view; 75. e and clc, inner view.

Male Genitalia. Hypandrium short triangular with few setae, phallus typical for genus, distally without spines. Epandrium with small hunch-shaped naked surstylus. Claspering cercus elongate strongly bent anteriorly, without setae at tip.

Measurements. Body length ♂ 2.5 mm, ♀ 2.2-2.7 mm. Wing length ♂ 2.2 mm, ♀ 2.1-2.7 mm.

Derivatio nominis. From *rotundus* (lat.) = circular, and *nota* (lat.) = spot, concerning the wing spots.

Relations. Two species have been described from the Oriental region: *D. flamingo* Smith (Arun Valley, Tumlingtar, Nepal), and *D. septemnotata* Brunetti (Simla, India). The colour pattern of the wing is often used to group the species. Both species mentioned above belong to the *Dolichocephala ocellata*-group, characterized by few circular translucent spots on the wing. And both are close relatives. They are distinguished by the pattern of circular spots on the wing, with *D. rotundinota* possessing small additional spots in the second submarginal, the second and third posterior cells and in the discal cell.

Dolichocephala spec. aff. flamingo

Material. 1♀ 14.11.1996; 1♀ 24.11.1996 (all LFSS).

Description. Female. Head dark brown, eye blackish. Thorax entirely brown. Antenna and mouth parts brown. Legs light brown, front, mid and hind coxae light brown. Wing without stigma, opaque with many more or less translucent spots differing in size and shape. Abdomen brown.

Measurements. Body length 2.3 mm. Wing length 2.7 mm.

Relations. Having no information on males, specimens may belong to *D. flamingo* or a related species.

Genus *Roederiodes* Coquillett, 1901

Type-species: *R. junctus* Coquillett (original designation).

Roederiodes specimens are easily distinguished from all other Clinocerinae by the long slender mouthparts.

***Roederiodes bilobatus* Wagner & Leese sp. nov.**

(Figs 70-71)

Material. Holotype: 1♂ 20.10.1997 (ZFMK).

Description. Male. Head dark brown, eye blackish, 1 oc, and 6-7 uniserial poc.

Thorax shining brownish black. Prothorax lighter with 1 pb. Mesonotum with pair of longitudinal blackish stripes, with 5 dc, no ac (?). Scutellum with 2 pairs of apical bristles, median bristles twice as long as lateral. Legs light brown. Front coxa yellowish, with distal bristle, middle- and hind coxae light brown. Tarsal segment 1 of hind legs with strong basal bristle. Wing opaque, no stigma. Veins M_2 and CuA_1 connected by distinct m-m cross-vein 4 times longer than basal peduncle of M_2 . The two parts of the 'X' connected by short horizontal part. Abdomen light brown.

Genitalia. Hypandrium slightly longer than high, setose along ventral margin. Epandrium rhomboid with basal margin slightly curved, apical margin broad and rounded, with distal fringe of long setae. Claspings cercus bilobed, proximal part almost straight, upright with

no pattern of setae, distal part triangular with round tip, on its inner side few short strong setae and large field with elongate fine setae along dorsal margin. Cercus very small. Phallus elongate, nearly straight, flagellum more than half length of basal part.

Measurements. Body length 3.0 mm. Wing length 3.0 mm.

Derivatio nominis. The name is derived from the bilobed claspings cercus.

***Roederiodes naggarensis* Wagner & Leese sp. nov.**

(Figs 72-73)

Material. Holotype: 1♂ 06.09.1996 (ZFMK).

Description. Male. Head dark brown, eye brownish black, 1 oc, 5-6 poc uniserial. Thorax brown, prothorax light brown with 1 pair pb; mesonotum with 5-6 dc and 3 ac ahead of proximal pair of dc. Scutellum with 1 pair of long apical and 2 pairs of lateral bristles, and 1 median bristle, all less than half length of long bristles. Legs yellow brown, coxae yellowish, legs increasingly darker towards brown tarsi. Front coxa distally with 3 strong bristles. Tarsal segment 1 of hind legs with 1 basal bristle. Wing opaque, without stigma. Veins M_2 and CuA_1 connected by distinct m-m cross-vein 4 times longer than basal peduncle of M_2 . Connection short x-shaped. Abdomen light brown.

Genitalia. Hypandrium slightly longer than high, ventral and dorsal margin slightly bent, setose along ventral margin. Epandrium short rhomboid, claspings cercus bilobed, proximal part upright bulbous, distal portion arising from same basis as proximal part strongly increasing in width distally. Proximal part nearly devoid of setae, distal part with wide field of strong and elongate setae. Surstylus small, almost invisible in lateral view. Cercus with some elongate setae. Phallus slightly bent, flagellum about half as long as basal part.

Measurements. Body length 3.0 mm. Wing length 2.8 mm.

Derivatio nominis. Naggare is the name of a village and stream in the study area.

***Roederiodes schwoerbeli* Wagner & Leese sp. nov.**

(Figs 74-75)

Material. Holotype: 1♂ 06.05.1997 (ZFMK); paratypes: 1♂ 05.11.1997 (NZSI); 1♂ 24.12.1997 (NHMB).

Description. Male. Head dark brown, with genotypical mouthparts. Eye brownish black, with 1 pair of short oc, and 5-6 uniserial poc. Antenna brown.

Thorax dark brown, pronotum yellow brown with 1 light brown pb, mesonotum with 5 dc and 1 very small ac. Scutellum with 5 bristles along distal margin, intermediate pair twice as long as lateral pair and central bristle.

Legs yellow brown, distally darker, tarsi brown. Hind legs with 2nd tarsomere 1.5 times longer than 4th. Wing brownish translucent, no stigma. Veins M_2 and CuA_1 connected by distinct m-m cross-vein, to form X-shaped pattern. Wing with basal costal bristle. Abdomen light brown.

Genitalia. Hypandrium slightly longer than high, setose along ventral margin. Epandrium short rhomboid. Claspings cercus bilobed, proximal part upright bulbous, distal part arising from central area of proximal part, increasing in width distally. On inner side along proximal margin small area covered with short fine setae and stouter setae, and similar field along distal margin. Surstylus very small not visible in lateral view. Cercus elongate sclerites at base of claspings cercus with several fine setae. Phallus elongate, distally bent, flagellum approximately half as long as basal part.

Measurements. Body length 2.8-3.0 mm. Wing length 2.9-3.0 mm.

Derivatio nominis. Dedicated to the late Prof. Dr. J. SCHWOERBEL, the renowned German running water ecologist, initiator and supporter of the study on Himalayan streams.

Roederiodes spec 1

Material. 1♀ 10.09.1996; 1♀ 23.09.1996; 1♀ 26.09.1996 (LFSS).

Description. Female. Head brown, with genotypical mouthparts; eyes dark, 1 oc, and 6 poc, uniserial; antenna dark brown. Thorax brown, prothorax with 1 pb. Mesonotum with 5 elongate dc and 3-4 ac anterior to first dc. Scutellum with 2 pairs of elongate apical bristles, lateral less than half as long as median.

Legs light brown, long and slender. Coxae yellowish, legs distally increasingly darker. Front coxa distally with 1 seta. Pretarsus of hind leg with 1 strong basal bristle. Wing brownish translucent, no stigma. Veins m_2 and cua_1 connected by distinct m-m cross-vein 4 times longer than basal peduncle of M_2 . Veins meet in distinct X-shaped pattern. Abdomen brown.

Measurements. Body length 2.1-2.4 mm. Wing length 2.5-3.1 mm.

Roederiodes spec 2

Material. 1♀ 21.09.1997 (LFSS).

Description. Female. Light brown to yellowish species. Head brown, 1 oc, 5-6 poc. Thorax yellow brown, prothorax with 1 pb. Mesonotum with 5 short dc, no ac. Scutellum with two pairs of apical bristles, medians more than three times longer than laterals. Legs yellowish brown. Coxae yellowish, legs distally increasingly darker. Front coxa distally with 3 setae. First segment of

hind leg with 1 strong basal bristle. Wing opaque, no stigma. Veins M_2 and CuA_1 with m-m cross-vein 3 times longer than basal peduncle of M_2 . Abdomen light brown.

Measurements. Body length 3.0 mm. Wing length 3.0 mm.

Roederiodes spec 3

Material. 1♀ 03.03.1998 (LFSS).

Description. Female. Head brown, eye darker, 1 oc, and 6 uniserial poc. Antenna light brown. Prothorax light brown, 1 yellowish pb. Mesonotum with 5 dc and 2-3 ac ahead of first pair of dc. Scutellum with two pairs of elongate apical bristles, lateral about half as long as central, and 1 pair of weak preapical bristles. Legs light brown, long and slender. Front coxa distally with 1 seta. First segment of mid-leg with 2 basal bristles, pretarsus of hind leg with 1 strong basal bristle. Wing opaque, no stigma. Veins M_2 and CuA_1 connected by distinct m-m cross-vein 3 times longer than basal peduncle of M_2 . Veins meet in distinct X-shaped pattern. Abdomen light brown.

Measurements. Body length 2.8 mm. Wing length 3.3 mm.

Relations. Three species groups of *Roederiodes* are distinguished in the Palearctic Region: one with a bilobed, another with a right-angled, and a third with an oval claspings cercus. *Roederiodes schwoerbeli* and *R. nagga-rense* belong to the group with a bilobed claspings cercus that also include *R. chvalai* Horvat, 1994 (Sichuan province, China) and *R. malickyi* Wagner, 1981 (Greece, Crete). *Roederiodes bilobatus* is remarkable in the possession of a very large cercal plate and does not belong to any of these groups. Females could not be successfully assigned to males and thus were separately described.

Genus *Wiedemannia* Zetterstedt, 1838

Type-species: *W. borealis* Zetterstedt (des. Coquillett 1903) (= *Heleodromia bistigma* Curtis)

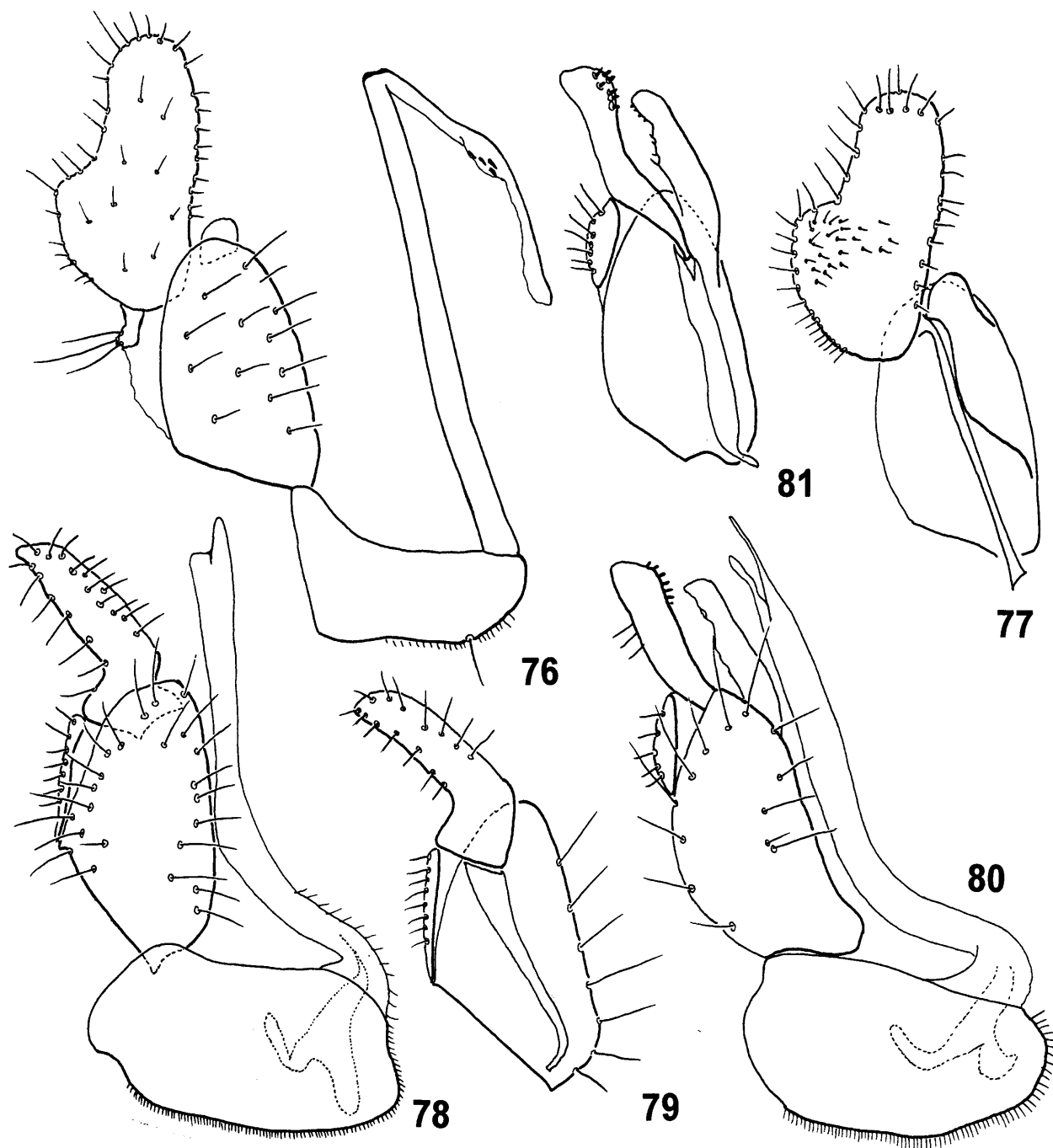
The lower margin of face of *Wiedemannia* specimens has a distinct notch. Males have a biarticulated phallus and an undivided claspings cercus. Females are difficult to distinguish but below were associated with males.

Wiedemannia glaucescens (Brunetti, 1917)

(Figs 76-77)

= *Wiedemannia saigusai* Smith, 1965

Material. 1♀ 06.07.1996; 1♂ 24.11.1996; 1♂ 25.12.1996; 1♀ 31.12.1996; 1♀ 14.02.1997; 2♂ 01.03.1997; 2♂ 02.03.1997; 1♀ 08.03.1997; 1♂ 2♀ 09.03.1997; 2♀ 15.03.1997; 1♀ 17.03.1997; 1♀ 25.03.1997; 1♀ 26.03.1997; 1♀ 27.03.1997; 1♀ 30.03.1997; 1♂ 01.04.1997; 1♀ 03.04.1997; 2♂ 08.04.1997; 1♀ 12.04.1997;



Figs. 76-77. *Wiedemannia glaucescens* (Brunetti): **76.** genitalia, lateral view; **77.** e, clc and ss, inner view. **Figs. 78-79.** *Trichoclinocera fluviatilis* (Brunetti): **78.** genitalia, lateral view; **79.** cpl, e, and clc, inner view. **Figs. 80-81.** *Trichoclinocera serrata* sp. nov.: **80.** genitalia, lateral view; **81.** cpl, e, clc and ss, inner view.

1♂ 18.04.1997; 1♀ 21.04.1997; 1♂ 1♀ 23.04.1997; 1♀ 05.05.1997; 1♂ 1♀ 14.06.1997; 1♂ 19.06.1997; 1♂ 21.06.1997; 1♀ 10.07.1997; 2♂ 11.07.1997; 5♀ 13.07.1997; 1♀ 19.07.1997; 1♂ 03.08.1997; 1♀ 06.08.1997; 1♀ 07.08.1997; 1♂ 02.09.1997; 1♀ 01.10.1997; 1♂ 14.10.1997; 1♂ 05.11.1997 (examples sent to the referred institutions).

This species, previously placed in the genus *Acanthoclinocera* Saigusa, seems to be widely distributed in the

Himalayas. It was reported by SMITH (1965) from Nepal and found to be the most abundant aquatic empidid in the present study. The above synonymy is based on SINCLAIR (1995).

Measurements. Body length ♂ 3.6-5.6 mm, ♀ 3.9-5.7 mm. Wing length ♂ 3.9-5.3 mm, ♀ 3.9-5.6 mm.

Genus *Trichoclinocera* Collin, 1941

Type species: *T. stackelbergi* Collin (original designation)

= *Seguyella* Vaillant, 1960. Type species: *S. rostrata* Vaillant (orig. des.)

= *Acanthoclinocera* Saigusa, 1965. Type species: *A. dasyscutellum* Saigusa (orig. des.)

The presence of macrotrichia on R_1 arising from the dorsal wing surface, and the fore femur with stout setae beneath sufficiently characterize *Trichoclinocera*.

***Trichoclinocera fluviatilis* (Brunetti, 1917)**

(Figs 78-79)

Material. 1♂ 10.09.1996 (LFSS)

Description. Male. Head dark brown, 1 oc, and 6 uniserial poc.

Thorax blackish brown. Pronotum with 1 pb, mesonotum black, with 2 ac, and 5 dc; scutellum with 1 pair of bristles. Legs brown, coxae yellowish. Front femur with 2 basal rows of thin bristles, and with 1 strong black bristle distally. Wing genotypical, brownish translucent, no stigma.

Genitalia. Large rectangular hypandrium. Phallus thick, strongly bent medially; tip at dorsal margin of claspings cercus, flagellum undeveloped. Epandrium triangular, with corners rounded. Cercal plates elongate and thin with row of setae. Claspings cercus simple, strongly bent, angle ~60°. Long distal portion covered with evenly distributed long setae. Surstylus small. Subepandrial sclerite simple, increasing in diameter distally, strongly bent near base.

Measurements. Body length 5.3 mm. Wing length 4.3 mm.

***Trichoclinocera serrata* Wagner & Leese sp. nov.**

(Figs 80-81)

Material. Holotype: 1♂ 12.10.1997 (ZFMK); paratypes: 1♂ 11.10.1997; 1♂ 15.09.1997; 1♂ 26.09.1997; 1♂ 9.10.1997; 1♂ 24.10.1997; 1♂ 13.11.1997. Further material: 1♀ 01.01.1997; 1♀ 09.10.1997; 1♀ 11.10.1997; 1♀ 26.09.1997; 2♀ 27.09.1997; 2♀ 30.10.1997; 1♀ 24.11.1997; (2 paratypes + 2♀ NZSI; 2 paratypes + 3♀ NHMB and LFSS).

Description. Head blackish, 1 oc, and 6 uniserial poc. Thorax dark brown. Pronotum with 1 pb, mesonotum black, with 2 ac, and 5 dc, scutellum with 2 pairs of bristles. Legs elongate, dark brown. Front femur with 2 asymmetric rows of bristles; basally with few very long bristles, central bristles short, lateral bristles longer. Wing opaque, no stigma.

Male Genitalia. Large and oval hypandrium. Phallus thick, strongly bent basally; tip at dorsal margin of claspings cercus, flagellum not developed. Epandrium oval, basal margin convex, distal margin slightly concave. Cercal plate elongate oval with row of long setae.

Claspings cercus simple, elongate, tip blunt. Dorsally on inner side with loose field of several strong spines. Surstylus elongate, frontal margin irregularly serrate, tip not reaching tip of claspings cercus. Subepandrial sclerite elongate, straight with small distal incision.

Measurements. Body length ♂ 3.5-4.8 mm, ♀ 4.1-5.6 mm. Wing length ♂ 4.4-4.8 mm, ♀ 4.7-5.8 mm.

Derivatio nominis. Derived from the serrate front margin of the surstylus.

Relations. The new species is very similar to *Trichoclinocera cyanescens* Vaillant from Tavilj Dara, Tadzhikistan. Differences: clc bent posteriorly in *T. cyanescens*, anteriorly in the new species; the ss of *T. cyanescens* has a sharp apical hook, not present in *T. serrata*.

Concerning the revision of the North American *Trichoclinocera* (SINCLAIR 1994) and the relevant features mentioned there, both species are closest to *T. dasyscutellum* (Saigusa, 1965). However, the large spines on the hind tibia were less evident in the above species and only in *T. fluviatilis* small spines were noticed.

5. DISCUSSION

Because systematics and ecology of the Himalayan Empididae species are poorly known any interpretation of relations to species groups beyond the Himalayas and in the Palearctic or Oriental Regions remains speculative at present.

Two genera of Hemerodromiinae were noted: *Hemerodromia* and *Chelifera*.

Hemerodromia species-groups are more difficult to distinguish than in *Chelifera*. The species described here show little resemblance to any known taxon or species groups from the Palearctic Region. However, the majority of species of *Hemerodromia* have been described from Europe and China (YANG & YANG, 1995), but almost nothing is known from Central Asia. A compilation into species groups based on the presence of a stigma, and on the colour pattern of the thorax was not successful. The morphology of the male genitalia between species is so variable that one may assume relatives may be found rather outside the Himalayas, and that species radiation within these mountains can be ignored.

In contrast, at least two species groups in *Chelifera* with several close relatives were distinguished. Species in the *C. rhombicercus* and *C. multisetula*-group were similar in colour pattern and in the shape of the male genitalia, and both groups have diversified in the Himalayas. Within each group features of particular sclerites of the genitalia were easily attributed to a basic pattern (e.g. the presence of spines along the margins of the cerci), indicating that they are descendents of a single ancestor.

Consequently adaptive radiation in individual species groups is evident.

In genera of the subfamily Clinocerinae we find relations to species groups that are distributed over large areas. In *Dolichocephala*, the *D. ocellata* or *D. irrorata*-groups are mainly based on the colour pattern of the wing; both species groups are distributed almost worldwide and it was not surprising to find group members in the Himalayas.

Roederiodes schwoerbeli and *R. naggarens* belong to a species group already known from the Palearctic Region characterized by a bilobed clasping cercus, that also includes *R. chvalai* Horvat (1994; Sichuan province, China), and *R. malickyi* Wagner (1981; Greece, Crete). *Roederiodes bilobatus* is remarkable in the possession of a very large clasping cercus and does not belong to this group. Females could not be successfully assigned to males and thus were separately described.

The *Clinocera* species mentioned above represent an element of the Himalayas and adjoining mountainous areas. *Clinocera minutissima* Vaillant and *C. stackelbergi* Vaillant were known from the Pamir area in Tajikistan (VAILLANT 1960). The distribution area of the groups includes at least parts of Zhijuan, China (YANG & YANG 1995a), and probably many species remain still undescribed. Several groups of close relatives can be combined according to the shape of the surstylus or the clasping cercus. However, the close relations between taxa provide a fascinating insight into speciation.

Two species of *Trichoclinocera* occurred in the samples, both probably related to the Palearctic, *T. dasyscutellum* (SAIGUSA, 1965). *Wiedemannia* was represented by only a single widely distributed species in the Himalayas, *W. glaucescens*.

Emergence and environmental variables

Disturbance regimes, in particular flash floods, and life-history evolution of aquatic insects are possibly correlated (LYTLE 2001, 2002). Concerning the pronounced cycle of seasons under climatic conditions of the monsoon, we compared various emergence data with maxima of environmental variables on a monthly basis.

Specimen numbers, however, were comparatively low in the present study and only *W. glaucescens* emerged almost continuously. Three other species with sufficient abundance demonstrated that temporal patterns (time and duration of emergence) seem to be important. The emergence pattern of *W. glaucescens* is correlated with the monthly amount of rain (Fig. 82). Four periods with high monthly precipitation occurred during the study period: August 1996, and March, August and December 1997. Emergence peaks of *W. glaucescens*, at least in March and July/August 1997 occurred mainly with high

precipitation. If discharge as an effect of precipitation is postponed, it means that emergence of that species occurs predominantly with increasing water level.

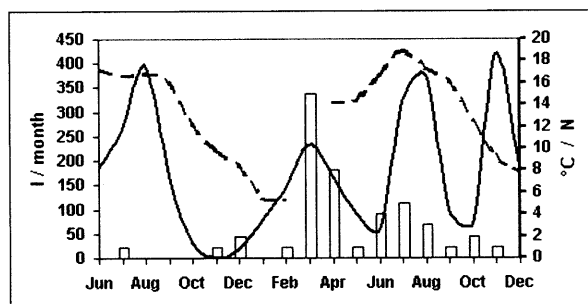


Fig. 82. Precipitation per month (solid, left axis) water temperature (broken, right axis) and monthly abundance of *Wiedemannia glaucescens* (right axis) on the Naggar stream, Himalaya.

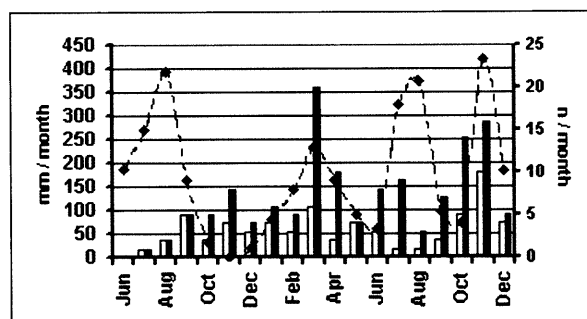


Fig. 83. Precipitation per month (line), monthly species (white column) and specimen (black column) numbers of Clinocerinae on the Naggar Nala, Himalaya (June 1996 – Dec. 1997).

If specimen and species numbers of all Clinocerinae are considered the impression is less clear (Fig. 83). Species and specimen numbers were highest in March and November 1997, which appears to follow the trend of precipitation over the entire study period. Specimen numbers were often high during periods of increasing or high precipitation in 1997, but also in November 1996 at low precipitation.

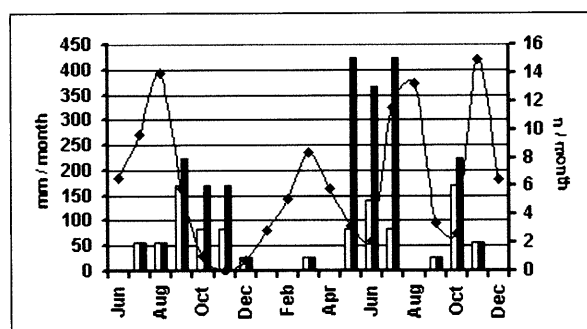


Fig. 84. Precipitation per month (line), monthly species (white column, right axis) and specimen (black column, left axis) numbers of Hemerodromiinae on the Naggar stream, Himalaya (June 1996 – Dec 1997).

The emergence pattern of Clinocerinae is dominated by the most abundant species, *W. glaucescens* (compare Figs 82, 83). *Trichoclinocera serrata* sp. n. was found only at the end of a period of decreasing precipitation and temperature (Fig. 85).

Emergence patterns of Hemerodromiinae are different (Figs 84, 85). There were several months, in particular January to April, August and December 1997, when no specimens emerged. In general, an increase of specimen and species numbers was observed in periods of decreasing or low precipitation; e.g., October, November 1996, May to July, and October 1997.

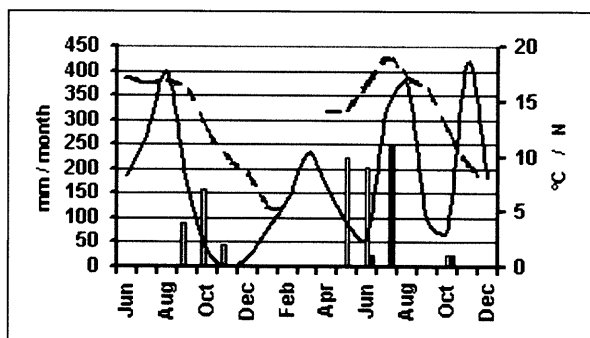


Fig. 85. Precipitation per month (solid line), monthly mean water temperature (broken line), and emergence of *Trichoclinocera serrata* (shaded column), *Chelifera haeselbarthi* (white column) and *Chelifera insueta* (black column) on the Naggar stream, Himalaya, June 1996 to December 1997.

The assessment of emergence pattern may vary with taxonomic resolution. However, comparing species emergence data of 1996 and 1997, it is not possible to recognize repetitious patterns between subsequent years. *Trichoclinocera serrata* emerged only from September to November 1996, no specimen was detected in the same period of the following year (1997). *Chelifera haeselbarthi* emerged during periods of decreasing or low precipitation, and *C. insueta* was abundant at the beginning of increased precipitation (Fig. 85). This may be due to life cycle characteristic of species (longer life cycle), weakness of the collecting method (collection area too small), or to the variability of stream sediments depending on flood events.

Species richness

Although data are scarce, we consider that the Naggar stream has an extraordinary rich fauna of aquatic Empididae, (Hemerodromiinae, Trichopezinae and Clinocerinae) with forty-nine taxa collected in about eighteen months. A decade was needed to collect twenty-nine species with the same sampling method and a comparable sampling effort at the Breitenbach, Schlitz, Germany (WAGNER & GATHMANN 1996). Species richness and abundance in a European highland and two alpine streams was even lower: Annaberger Bach, Bonn,

Germany, 10 species in one year (CASPER & WAGNER 1982); Teichbach (14 species, 3 years) and Schreierbach (21 species, 3 years), both streams Lunz am See, Austria (WAGNER 1982).

Biodiversity of aquatic Empididae is extraordinarily high in the Himalayas, probably due to its position at the border of the Palearctic and the Oriental Regions, and further may depend on the variability of climatic zones along the different slopes and elevations (biogeographic and climatic 'ecotones') of the mountain chains.

Number and morphological similarity of species, predominantly in *Clinocera* are an indication of continually and very active processes of radiation and speciation. A temporal separation of emergence periods of close relatives, however, was not evident. A larger amount of material and ecological studies in the stream are needed to confirm these assumptions.

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APPENDIX I:

Temporary key to males of the SW-Himalayan species of *Chelifera* Meigen

- | | | | | | |
|------|--|----------------------------|------|---|----------------------------|
| 1 | – Wing without pterostigma | 2 | 5(4) | – Dorsal margin of cercus ca. straight | |
| | – Wing with pterostigma | 4 | | | <i>stauderae</i> n.sp. |
| 2(1) | – Thorax pale yellow, postgonite absent | | | – Dorsal margin of cercus sinuous..... | 6 |
| | | <i>haeselbarthae</i> n.sp. | 6(5) | – Epandrium with 3 strong setae, genitalia (Figs. 18-19)..... | <i>rhombicercus</i> n.sp. |
| | – Thorax brownish..... | 3 | | – Epandrium with 1 strong seta, genitalia (Figs. 16-17)..... | <i>curvata</i> n.sp. |
| 3(2) | – Dorsal margin of cercus simple, bent..... | | | | |
| | | <i>accomodata</i> n.sp. | 7(4) | – Cercus rhomboid, dorsal margin irregularly serrate, postgonite large with horizontal appendage, hypandrium shallow tub-shaped, genitalia (Figs. 3-5)..... | <i>insueta</i> n.sp. |
| | – Dorsal margin of cercus with upturned ‘nose’ | <i>digitata</i> n.sp. | | – Hypandrium with simple process and postgonite | 8 |
| 4(1) | – Mesonotum or entire thorax dark brown, pterostigma distinctly black..... | | 8(7) | – Opening between cerci narrow, hypandrial process thin, less than half length of postgonite, genitalia (Figs. 8-10)..... | <i>multiseta</i> n.sp. |
| | <i>rhombicerca</i> group | 5 | | – Opening between cerci wide, hypandrial process broad, more than half length of postgonite, genitalia (Figs. 12-15)..... | <i>multisetoides</i> n.sp. |
| | – Mesonotum light brown to brown, pterostigma faint, more or less elongate ... | <i>multiseta</i> group.. | | | |
| | – Mesonotum reddish brown, pterostigma brown, distinct, caudal margin of cercus with upturned ‘nose’ | <i>brevidigitata</i> n.sp. | | | |

APPENDIX II:

Temporary key to males of Hemerodromia Meigen from the Himalayas and China based only on lateral aspects of male genitalia

- 1 – Cercus with several dorsal digitate processes . 2
 - Cercus bilobed..... 4
 - Cercus simple 8
- 2(1) – Cercus with wide U-shaped incision
 -*menghaiensis* Yang & Yang (**China**)
 - Cercus with narrow 3
- 3(2) – Dorsal margin of cercus with more than two spined tips.....
 -*furcata* Grootaert, Yang & Saigusa (**China**)
 - Dorsal margin of cercus with two spined tips...
 -*menglunana* Grootaert, Yang & Saigusa (**China**)
- 4(1) – Incision on distal (short) side of cercus..... 5
 - Incision on dorsal (long) side of..... 7
- 5(4) – Incision deep, inner lobe of epandrium with two large spines.....*serpa* Smith (**Nepal**)
 - Incision shallow..... 6
- 6(5) – Epandrium thin, elongate
 -*striata* Yang & Yang (**China**)
 - Epandrium triangular, short.....
 -*fusca* Yang & Yang (**China**)
- 7(4) – Distal part of cercus slightly longer than wide..
 -*digitata* Grootaert, Yang & Saigusa (**China**)
 - Distal part of cercus twice as long as wide
 -*concava* Yang & Yang (**China**)
- 8(1) – Cercus large, extensive, less than two times longer than wide 9
 - Cercus narrow elongate, more less than two times longer than wide 10
- 9(8) – Cercus oval, with 5 setae inside along distal margin, hypandrium with postgonite
 -*elongatoides* n.sp. (**SW-Himalayas**)
 - Cercus and periandrium rhomboid, cercus with dorsomedian field of setae.....
 -*rhomboides* n.sp. (**SW-Himalayas**)
- 10(8) – Cercus bent, increasing in width distally, often with distal ‘knob’ 11
 - Cercus more or less straight, decreasing in width distally 17
- 11(10) – Cercus bent anteriorly *pila* Smith (**Nepal**)
 - Cercus bent posteriorly..... 12
- 12(11) – Cercus strongly bent posteriorly
 -*curvata* Grootaert, Yang & Saigusa (**China**)
 - Cercus slightly bent posteriorly, almost straight 13
- 13(12) – Distal margin of cercus serrate.....
 -*apiciserrata* Grootaert, Yang & Saigusa (**China**)
 - Distal margin of cercus smooth..... 14
- 14(13) – Cercus slightly bent
 -*fujanensis* Yang & Yang (**China**)
 - Cercus almost straight 15
- 15(14) – Epandrium sharp triangular
 -*guangxiensis* Yang & Yang (**China**)
 - Cercus blunt triangular 16
- 16(15) – Cercus with strong inner distal setae, without apical epandrial lobe.....
 -*acutata* Grootaert, Yang & Saigusa (**China, SW-Himalayas**)
 - Cercus without strong setae, with apical epandrial lobe*spinosa* n.sp. (**SW-Himalayas**)
- 17(10) – Cercus distally acute 18
 - Cercus distally blunt 20
- 18(17) – Distal half of cercus thin.....
 -*elongata* Yang & Yang (**China**)
 - Tip of cercus shorter 19
- 19(18) – Upper edge of epandrium almost straight
 -*chita* Smith (**Nepal**)
 - Upper edge of epandrium bent
 -*euneura* Yang & Yang (**China**)
- 20(17) – Tip of cercus in dorsal view trifold
 -*chitaoides* n.sp. (**SW-Himalayas**)
 - Tip of cercus in dorsal view bifid.....
 -*lomri* Smith (**Nepal**)
 - Tip of cercus simple in lateral view 21
- 21(20) – Phallus and its lateral processes thin acute, strongly bent
 -*mengyangana* Grootaert, Yang & Saigusa (**China**)
 - Phallus almost straight..... 22
- 22(21) – Cercus sinuous.....
 -*yunnanensis* Yang & Yang (**China**)
 - Cercus bent clockwise 23
- 23(22) – Epandrium with large oval apical projection
 -*flaviventris* Yang & Yang (**China**)
 - No visible apical projection 24
- 24(23) – Epandrium tip bent dorsally
 -*beijingensis* Yang & Yang (**China**)
 - Epandrium tip straight
 -*puerensis* Yang & Yang (**China**)

APPENDIX III:

Temporary key to males of *Heleodromia* Haliday from the Himalayas based only on lateral aspects of male genitalia

- | | |
|--|--|
| 1 – Tergite 8 with process 2
– Tergite 8 without process 3
2(1) – Tip of process sharp, hypandrium with upright
prolongation <i>ausobskyi</i> Wagner (Nepal)
– Tip of process blunt, hypandrium without pro-
longation <i>rami</i> n.sp. (SW-Himalayas) | 3(1) – Blackish, long setae on basal half of front and
middle femora <i>hilo</i> Smith (Nepal)
– Brownish-green, long setae only on front fe-
mur <i>obscura</i> (Brunetti) (W-Himalayas) |
|--|--|

APPENDIX IV:

Temporary key to males of *Clinocera* Meigen from the Himalayas and China based on genital features

- | | |
|--|--|
| 1 – Claspig cercus (clc) setose 2
– clc ‘naked’ 3
2 – Surstylus (ss) thin, naked ... <i>pani</i> Smith (Nepal)
– ss broad with a small proximal tip, a few large
setae on both sides
..... <i>setosa</i> n.sp. (SW Himalayas)
3 (1) – clc broad, < 2.5 as long as wide 4
– clc thin, > 3 times longer than wide 8
4(3) – clc with sharp tip 5
– clc with blunt tip 6
5(4) – clc arrowhead-shaped, dorsal rim of ss sinuous
..... <i>cuspidata</i> n.sp. (SW Himalayas)
– clc short triangular, or dorsal rim of ss straight
..... <i>nadi</i> Smith (Nepal)
6(4) – clc widest in the middle, with blunt tip
..... <i>sinclairi</i> n.sp. (SW Himalayas)
– clc with straight dorsal rim 7
7(6) – clc with many setae inside, ss broad sickle-
shaped
..... <i>lunata</i> n.sp. (SW Himalayas)
– clc with few setae inside, ss thin sickle-shaped
..... <i>lunatoides</i> n.sp. (SW Himalayas) | 8(3) – clc triangular with sharp tip 9
– clc elongate with round tip 10
9(8) – Epandrium dorsally rounded
..... <i>sinensis</i> Yang & Yang (China)
– Epandrium dorsally straight
..... <i>wui</i> Yang & Yang (China)
10(8) – clc 3-4 x longer than wide 11
– clc 5-6 x longer than wide 12
11(10) – clc ~3 x longer than wide, ss small with dis-
tinct anterior tip <i>minutissima</i> Vaillant
..... (Tadjikistan, SW Himalayas)
– clc ~4 x longer than wide, ss broad with dorsal tip
..... <i>stackelbergi</i> Vaillant
..... (Tadjikistan, SW Himalayas)
12(10) – clc bent anticlockwise
..... <i>chilamche</i> Smith (Nepal)
– clc upright or bent clockwise 14
13(12) – ss high and broad, with a short ‘nose’
..... <i>marginetosa</i> n.sp. (SW Himalayas)
– ss basally oval, with a long ‘nose’
..... <i>longicercus</i> n.sp. (SW Himalayas) |
|--|--|