

## GUIDE TO THE AQUATIC HETEROPTERA OF SINGAPORE AND PENINSULAR MALAYSIA. V. HYDROMETRIDAE

**Chang Man Yang**

*c/o Raffles Museum of Biodiversity Research, Department of Biological Sciences,  
National University of Singapore, Singapore 119260  
Email: dbsycm@nus.edu.sg*

**Herbert Zettel**

*Natural History Museum, International Research Institute of Entomology,  
Burgring 7, A-1010 Vienna, Austria  
Email: herbert.zettel@nhm-wien.ac.at*

**ABSTRACT.** – This is the fifth part of a series of guides to the aquatic Heteroptera of Singapore and Peninsular Malaysia. The family Hydrometridae, with 14 species of the genus *Hydrometra* are known from the Peninsula. A key to 19 species of *Hydrometra* found in Southeast Asia is presented. Illustrations for the key characters of each species are provided. *Hydrometra akekawati* Sites & Polhemus, 2003 is synonymized with *H. okinawana* Drake, 1951.

**KEY WORDS.** – Hydrometridae, Singapore, Peninsular Malaysia, Southeast Asia, *Hydrometra*, *Heterocleptes*, key to species, new synonymy.

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### INTRODUCTION

The family Hydrometridae, commonly known as water-measurers or marsh treaders, is a group of very distinctive bugs with elongated body and with eyes far behind the anterior margin of the peculiar head (Fig. 3). There are three subfamilies (Hydrometrinae, Heterocleptinae, and Limnobatodinae) comprising seven living genera in the world (Andersen, 1977, 1982b). Only the subfamily Hydrometrinae is found in Singapore and Peninsular Malaysia. Another subfamily, Heterocleptinae, has been recorded from Sabah (Borneo).

### SUBFAMILY HETEROCLEPTINAE

This subfamily can be easily separated from Hydrometrinae by much shorter body (length 3 mm). Included genera are *Heterocleptes* and *Veliometra*. The latter is found in Brazil. *Heterocleptes* is a primitive genus; originally with 3 species known only from Africa, but a fourth species, *H. spinosus* (Fig. 1) was reported from Sabah by Andersen (1982b). Recently, Andersen and Grimaldi (2001) described a new fossil hydrometrid, *Carinametra burmensis* from a mid-Cretaceous Burmese amber (100-90 Ma) from north of Myanmar. They placed the genus in Heterocleptinae and suggested that this subfamily has been more widely distributed in the past.

### SUBFAMILY HYDROMETRINAE

There are four genera in this subfamily: *Bacillometra* (South America), *Chaetometra*, *Dolichocephalometra* (Marquesas Islands), and the cosmopolitan *Hydrometra*. The genus *Hydrometra* is common and widespread in Southeast Asia.

The body length of *Hydrometra* ranges from 7 to 18 mm. They are usually brownish, dark greenish or blackish in colour. Species of *Hydrometra* are quite uniform in general structure, the detailed morphology has been studied by Andersen (1982a) and Polhemus & Polhemus (1995). Some characteristics that are important for species identification are mentioned here.

The elongated head is about 1/3 of the body length; eyes are far away from the anterior margin and divide the head into anteocular (AO) and postocular (PO) parts (Fig. 2). The length ratio of the AO : PO is sometimes helpful for identification. Antennae are long and semiflagelliform, about half of the body length. The shape of anteclypeus (or clypeus, Figs. 2, 12) and its anterior margin vary among different species. It is important for species identification as well as for separation of species groups. Most species have rounded, acute or spine-like anterior, others have broadly rounded to almost straight anterior. The broad anteclypeus with truncate or concave anterior margin type is considered as the most plesiomorphic character state (Andersen 1977, 1982a) and defines a distinct,

widely distributed species group. In the Oriental Region, *Hydrometra brevitarsus*, *gilloglyi*, *heoki* and *julieni* belong to this group. The gular lobe and maxillary plate (Figs. 2, 26, 39) are variable among some species, for example, *H. carinata* has enlarged maxillary plates.

The thorax is shorter than the head, the distinctive pronotal lobe is covered with punctures and the acetabula usually with acetabular pits. The number of pits differs slightly among species. Some brachypterous females of *H. longicapitis* bear a long tubercle process on the posterior of the pronotal lobe (Fig. 4), this unusual polymorphism has not been observed in other species (Andersen, 1992; Polhemus & Polhemus, 1995). The legs of *Hydrometra* are long and thread-like, and have 3-segmented tarsi with terminal claws. The modification of legs is mainly through length, with the exception of the species group *H. maidli-borneensis-annamana* that has a row of hairs on the hind femora of the male.

The wing venation is reduced as compared to most other semi-aquatic bugs. In the macropterous (mapt) morph the wings are long, covering most of the abdominal tergites. In the brachypterous (brpt) morph the wings are reduced to narrow straps, which hardly extend onto the surface of the abdomen. In apterous (apt) (or micropterous) morph the wings are either completely covered by the pronotal lobe, or just visible as very tiny pads behind its hind margin. Information on wing morphs is often a valuable hint for recognition of species. In general, *Hydrometra* species usually occur in two different

morphs. Most species have a brachypterous and a macropterous morph. Some species are only known for one morph, an apterous (or micropterous) or a macropterous morph. A few species are only known in brachypterous morph, but the occurrence of macropterous specimens has to be expected. In the key we mention the more common morph first, followed by the less common, e.g., “mapt or brpt”. If one morph occurs rarely, it is put in parenthesis, e.g., “mapt (or brpt)”.

The abdomen (Figs. 3, 4) is relatively long, covered with short and fine pubescence, and some long setae. The mediotergites are narrow, and the width to length ratio is useful in separating some closed related species. Laterotergites (connexiva or paratergites) of some species carry long erected setae (Figs. 23, 24, 33, 51). Sternite 7 of the male is modified. Some are transversely concave and dispersed with long setae (Fig. 40); some with patches of short hairs or with a pair of clustered set of long setae (Figs. 14, 18), or modified with thorn-like, or spine-like process (Figs. 29, 50, 80, 88), whilst *H. longicapitis* has a pair of very distinct fleshy tubercle processes on the anterior of sternite 7 (Fig. 66). Segment 8 of male is usually not modified, but some species have slight depression or paired cluster of setae ventrolaterally (Figs. 36, 45, 47). The posterodorsal corners are usually rounded, but a few species have distinct outward process because of the expanded wing-like structure of the pygophore (S9) (Fig. 62). The sternite 7 of the female is not modified, but its length and shape, as well as the terminal process of tergite 8 are useful characters for species identification.

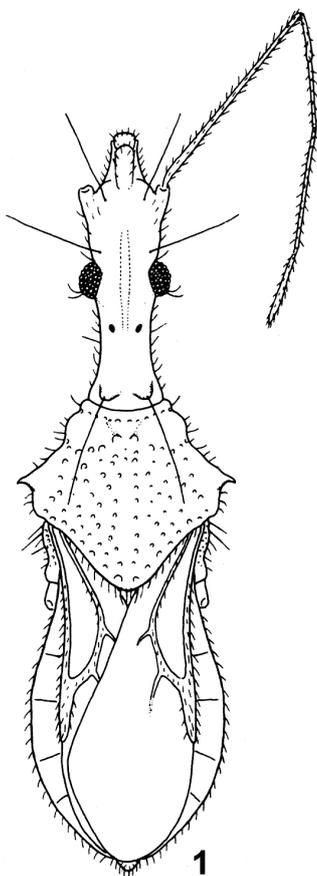


Fig. 1. *Heterocleptes spinosus* Andersen, macropterous female (from Andersen, 1982).

## BIOLOGY AND DISTRIBUTION

*Hydrometra* is a common and diverse genus, with about 100 species distributed world-wide. Early publications on *Hydrometra* of the region are mainly from Indonesia (Lundblad, 1933; Hungerford & Evans, 1934). Fernando and Cheng (1974) recorded seven species from Malaya and Singapore, subsequently more species were reported from this area by Andersen (1992), Polhemus & Polhemus (1995), Yang & Kovac (1995), Yang et al. (1997a, b), and Zettel & Yang (2004). Fourteen species are now represented in the Malay Peninsula (Table 1). Most of these species are common and widespread from Indochina to the Sunda Islands, whilst a few have not yet been recorded from Borneo. A total of 19 species are distributed in Southeast Asia. Table 1 lists all species known from South China (Yunnan), Indochina, the Malay Peninsula, Sumatra, Java and Borneo, mainly based on material deposited in the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research and the Natural History Museum of Vienna (NHMW); some are literature records (Lundblad, 1933; Hungerford & Evans, 1934; Andersen, 1982b, 1992; Chen & Andersen, 1993; Polhemus & Polhemus, 1995; Sites & Polhemus, 2003; Hua, 2000).

*Hydrometra* live near the edge of vegetated standing water, or on shores or surface of slow flowing streams. The most common and widespread species are those found in both

lowland and highland habitats (e.g. *longicapitis*, *cracens*, *orientalis*). A few prefer to live around hill streams in forest of different elevations (e.g. *kelantan*, *gilloglyi* and *jaczewskii*) whilst *chaweewanae*, *carinata* and *okinawana* are usually found in lowland swamp forest. It is very common that several species are found in the same habitat. For example, *H. longicapitis* always co-exists with one or more than one other species, more commonly with *cracens* (also observed by Polhemus & Polhemus, 1995), or with *orientalis*, *maidli* and *julieni*. In Singapore, *H. longicapitis* is rare, whilst *maidli* is the most common species encountered in both, temporary and permanent waters, especially in open country habitats. The species is always present in small numbers, sometimes found with *orientalis* or *carinata* in the forest. *H. maidli* has been collected with *orientalis* from a brackish pool between the mud-lobster (*Thalassina anomala*) mounds in Singapore mangroves (D. H. Murphy, per. comms.). Some species are capable in dispersal by flight and are attracted by light.

*Hydrometra* are predaceous and feeding upon dead or drowned insects which are floating on the water surface. Unlike other water striders, they are unable to hold their prey with their thread-like fore legs, but are able to spear microcrustaceans, mosquito larvae, and other prey through the water film (Andersen, 1977). They are also preyed upon by other animals, such as birds and frogs (Bullock, 1966). The slender body with the threadlike legs camouflages well among the weeds or debris as twigs when motionless. This acts as an effective behaviour against predators. Fast escape is always observed in all species. At least two species (*H. longicapitis* and *heoki*) have been observed running across water surface of slow flowing streams in freshwater swamps in Johor (West Malaysia) and Borneo, or quickly up to the muddy banks when pursued (Polhemus & Polhemus, 1995; H. H. Tan and C. M. Yang, pers. observations). They are well adapted for movement over wet soil and specimens have been collected from puddles some distant (about 100 m) away from the stream.

The life cycle and biology of two American species, *Hydrometra martini* and *H. hungerfordi* have been studied by Hungerford (1920) and Wood & McPherson (1995). The females laid the eggs (about 2 mm long) on almost any object 2-3 cm above the water surface. The first instar (nymph) emerged after the incubation period of about 8 days. There are five instars, each stage molted after 2 to 5 days of development and completed a cycle in 15 days. The life span ranged from 7 to 15 months under laboratory conditions. Nymphs are similar to adults in appearance, but smaller in size. Their body is soft and paler, usually light yellowish, in some species with orange colour. The detailed development of *H. hungerfordi* shows the 5 instars can be separated by the relative proportion of the anteocular and postocular lengths, the degree of development of wing pads and the length of the hind femora. The wing pads first occur in the second instar (Wood & McPherson, 1995).

**KEY TO THE SPECIES OF HYDROMETRIDAE OF SINGAPORE AND PENINSULAR MALAYSIA**

The comprehensive revision by Polhemus & Polhemus (1995) provides a very useful identification key to the *Hydrometra* species of Indochina and the western Malay Archipelago; it is mainly based on characteristics of males. Another key by Zettel and Chen (1996) allows the identification of males and females, but is restricted to the very limited number of species known from Thailand at that time. Our key partly follows these keys, but we try to have additional characteristics and provide SEM photographs for easier identification. The key presented here is for *Hydrometra* species known from Southeast Asia until Wallace's Line. A key for the identification of females is also provided. The identification of females is difficult if males are absent, especially among females of the same species group which are very similar to each other. Moreover, two or more species of *Hydrometra* (often even closely related species) often inhabit the same

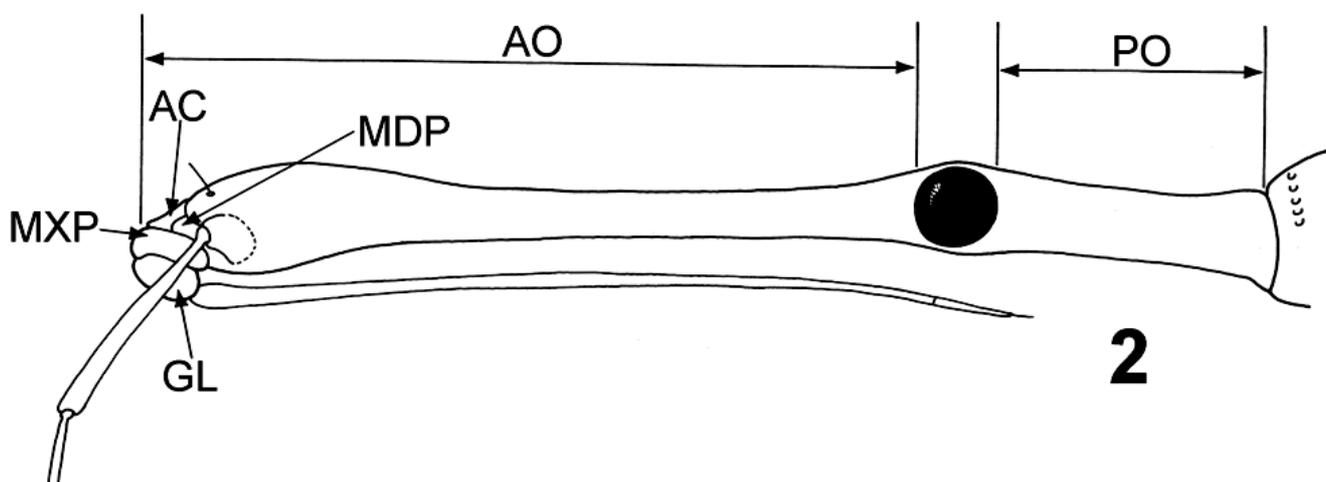


Fig. 2. Head of *Hydrometra* (from Polhemus & Polhemus, 1995). Abbreviations: AC, anteclypeus; AO, anteocular distance; GL, gular lobe; MXP, maxillary plate; MDP, mandibular plate; PO, postocular distance.

ecosystem, and therefore females do not always belong to the same species as the males from the same sampling.

The key to the species of *Hydrometra* of Singapore and Peninsular Malaysia includes several species, which are not recorded from the peninsula. The fact, that *Hydrometra* species display an ecological rather than a geographical divergency, makes the occurrence of more species possible. Such species, which are not yet recorded from the Malay Peninsula, are put in parenthesis [ ]. A few species and subspecies, which are obviously allopatric with such recorded from the Malay Peninsula, are also mentioned in parenthesis.

Abbreviations:

- AO    anteocular distance
- apt    apterous or micropterous
- brpt    brachypterous
- mapt    macropterous
- MTaI    middle tarsus index: length of second middle tarsal segment : length of third middle tarsal segment
- MTiI    middle tibia index: length of middle tibial segment : combined length of middle tarsal segments
- PO    postocular distance
- PT8    posteromedian process of female tergite 8 (T8) or male segment 8 (Sg8)
- S7    sternite 7
- Sg8    segment 8 (male)

- T7    tergite 7 or mediotergite 7
- T8    tergite 8 or mediotergite 8 (female only)

**Key to genera of Hydrometridae**  
(modified from Andersen, 1982a)

- 1. First antennal segment much longer than second segment. Eyes located about middle of head, AO subequal in length to PO (Fig.1). Length 3.0-5.0 mm ..... [*Heterocleptes* Villiers] (species *spinus* Andersen, subfamily Heterocleptinae, Borneo only)
- First antennal segment subequal to or shorter than the second segment. Eyes located far behind middle of head, AO distinctly longer than length of PO (Figs. 2, 3, 4). Length 7.0-18.0 mm ..... *Hydrometra* Latreille (subfamily Hydrometrinae, widespread)

**Key to the species of *Hydrometra***  
(modified from Polhemus & Polhemus, 1995 and Zettel & Chen, 1996)

- 1. Anteclypeus distinctly shorter than wide, with anteromedial depression, and with slightly concave anterior margin (Figs. 20, 34, 43, 52) ..... 2
- Anteclypeus usually longer than wide, without anteromedial depression, and with round or pointed anterior (Figs. 12, 38, 78, 81). [Except in *H. ripicola*, anteclypeus slightly shorter than wide and anterior margin truncate (Fig. 86)] ..... 5

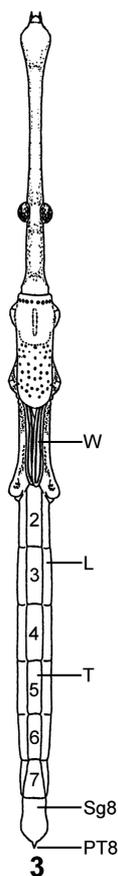


Fig. 3. *Hydrometra longicapitis* Torre-Bueno, brachypterous male with appendages removed, dorsal view. Abbreviations: L, laterotergite; PT8, posterior process of segment 8 (Sg8); T, tergite; W, wing.

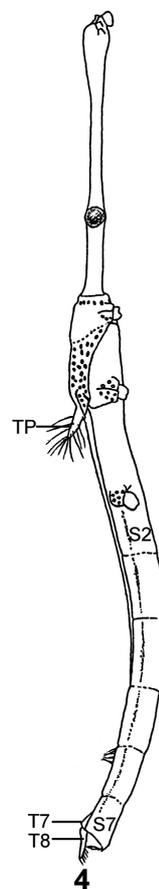
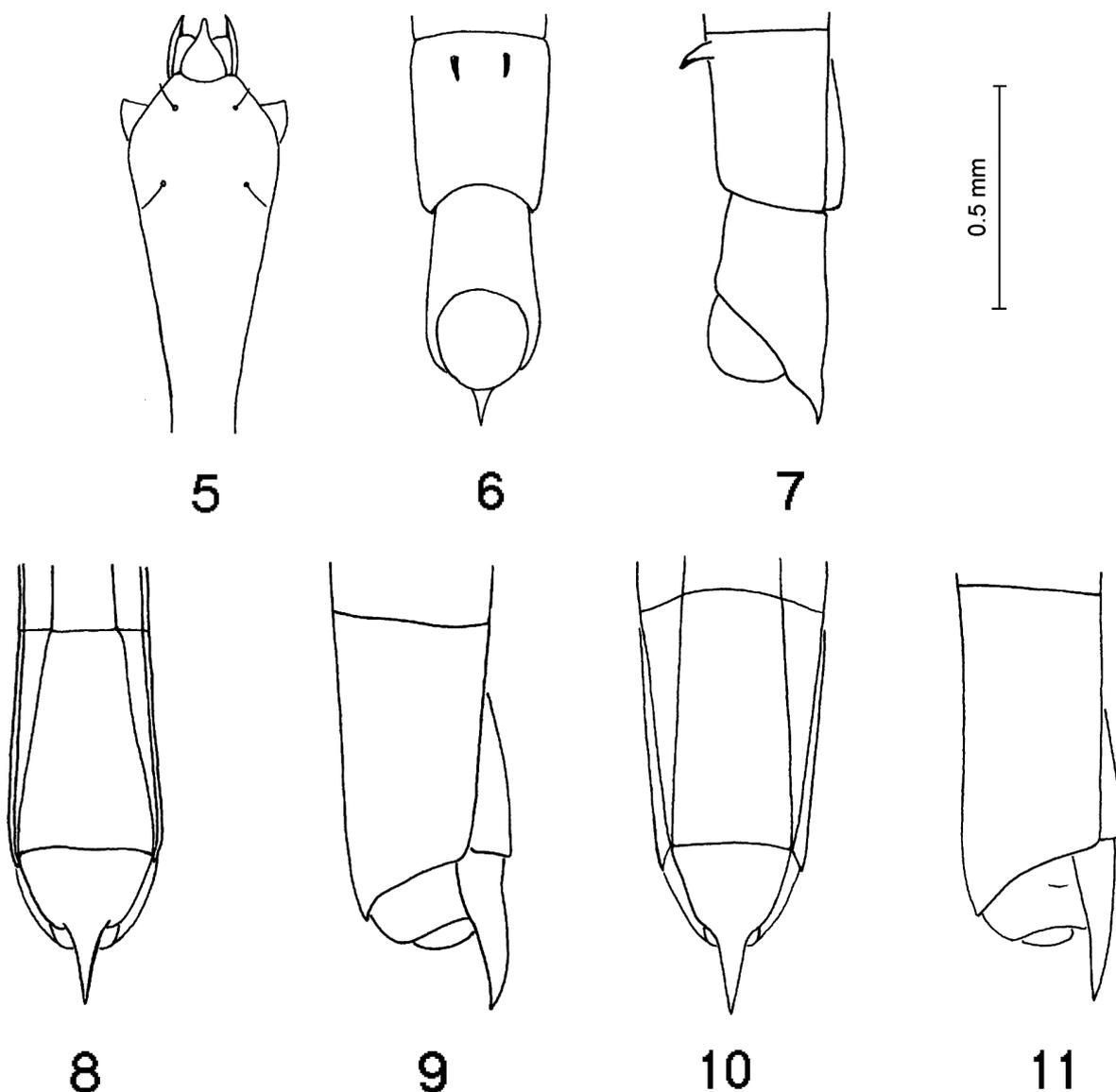


Fig. 4. *Hydrometra longicapitis* Torre-Bueno, brachypterous female with appendages removed, lateral view. Abbreviations. S2-7, sternites 2-7; T7-8, tergites 7-8; TP, tubercle process.

- 2. Tarsus of middle leg very short, MTII = 9-11. Venter light brown. Male: S7 with pair of large pad-like projections. Female: PT8 absent, S7 strongly produced caudad (Figs. 20-24); apt. ....  
..... *H. brevitorsus* Zettel & Yang
- Tarsus of middle leg long, MTII < 7. Venter blackish brown. Male: S7 without pair of large pad-like projections. Female: PT8 present, S7 not strongly produced ..... 3
- 3. Male: Sg8 without paired tufts of setae, S7 not depressed, with paired patches of short setae posterolaterally. Female: T8 directed straight caudad (Figs. 52-55); brpt (or mapt) .....  
..... *H. julieni* Hungerford & Evans
- Male: Sg8 with paired tufts of laterad directed short setae (Figs. 36, 45, 47). S7 posterior half depressed, dispersed with long setae (Figs. 35, 44). Female: T8 directed ventrocaudad (Figs. 37, 46) ..... 4
- 4. Wing straps of brachypterous morph distinctly surpassing middle of tergite 2, usually nearly reaching its hind margin. Male: longer paired tufts of setae on Sg8, and extending to posterior margin. Depression of S7 short. Female: abdomen weakly upcurved, T8 straight or weakly downcurved. S7 with distinct posteromedial downward button-like protrusion (Figs. 34-37); brpt or mapt .....  
..... *H. gilloglyi* Hungerford & Evans
- Wing straps of brachypterous morph usually not (very rarely weakly) surpassing middle of tergite 2. Male: shorter paired tufts of setae on Sg8 not reaching posterior margin. Depression of S7 long. Female: abdomen distinctly upcurved, T8 distinctly downcurved. S7 with normal or slight posteromedial protrusion (Figs. 43-47); brpt or mapt ..... *H. heoki paya* Zettel & Yang (Also key to *H. heoki heoki* Zettel & Yang, brpt (or mapt); an allopatric subspecies distributed in Borneo)
- 5. Male: S7 modified, T8 fused with sternite 8 ..... 6
- Female: S7 not modified, T8 separated from sternite 8 .... 20
- 6. Anteclypeus broad with parallel sides in dorsal view (except in *H. carinata*, sides not parallel, but with broadly rounded anterior) (Figs. 25, 65, 86) ..... 7
- Anteclypeus somewhat triangular or conical shape, with pointed or bluntly rounded anterior in dorsal view (Figs. 5, 12, 16, 30, 38, 48, 56, 60, 74, 78, 81) ..... 9



Figs. 5-9: *Hydrometra chaweewanae* Sites & Polhemus. 5. Apex of head, dorsal view showing anteclypeus; 6. Male terminal abdomen, ventral view; 7. Male terminal abdomen, lateral view; 8. Female terminal abdomen, dorsal view; 9. Female terminal abdomen, lateral view. *Hydrometra okinawana* Drake: 10. female terminal abdomen, dorsal view; 11. female terminal abdomen, lateral view.

7. S7 ventral outline straight, surface normal, with pair of clusters of spines or thorns ..... 8
- S7 ventral outline not straight, and with strongly concave posterior, surface with distinct transverse groves; anteriorly with paired large "fleshy" tubercle processes, but without clusters of spine-like process (Figs. 65-67); brpt (or mapt) ..... *H. longicapitis* Torre-Bueno
8. S7 anteriorly with paired humps bearing clusters of short thorns. Maxillary plate of normal size (Figs. 86-88); apt ..... [ *H. ripicola* Andersen ] (North Thailand)
- S7 without paired humps; clusters of spines located 1/3 from anterior margin. Maxillary plate very large (Figs. 25, 26, 28, 29); brpt (or mapt) ..... *H. carinata* Polhemus & Polhemus
9. S7 anteriorly with a pair of processes, which usually consists of a cluster of spines or setae (Figs. 31, 32, 49, 50, 75, 76, 79) ..... 15
- S7 anteriorly without a pair of processes ..... 10
10. S7 ventrally strongly concave in lateral view, with dispersed long setae (Figs. 40, 57), but without distinct paired patches of short hairs ..... 11
- S7 ventral outline straight in lateral view, with distinct paired patches of dense short hairs (Figs. 13, 17, 70) or with dispersed long setae (Figs. 61, 82) ..... 12
11. MTaI about 2.3. Sg8 with strong posterolateral outward corners. Body colour medium to blackish brown (Figs. 56-59); mapt (or brpt) ..... *H. kelantan* Polhemus & Polhemus
- MTaI about 1.8. Sg8 with weak posterolateral corners. Body colour light to medium brown (Figs. 38-42); mapt (or brpt) .. *H. greeni* Kirkaldy
12. S7 with paired patches of short and dense hairs, S6 and S7 without dispersed long setae. Hind femur lined with long erect hairs (hairs sometimes "sticking" to femur and then not well visible in dry specimens) ..... 13
- S7 without paired patches of short hairs, S6 and S7 with dispersed long setae. Hind femur not lined with long hairs ... ..... 19
13. S7 with distinct rounded patches of short hairs near to middle (Figs. 12-14); mapt or brpt ..... [ *H. annamana* Hungerford & Evans ] (Thailand, Vietnam and southern China)
- S7 paired patches of short hairs not distinctly rounded, located posteriorly (Figs. 17, 70) ..... 14
14. Patches of hairs not extending to posterior margin of S7 (Figs. 69-71); mapt or brpt ..... *H. maidli* Hungerford & Evans
- Patches of hairs extending to posterior and posterolateral margins of S7 (Figs. 16-18); brpt or mapt .... [ *H. borneensis* Zettel & Yang ] (Borneo, an allopatric species of *H. maidli*)
15. Anteclypeus with very acute or spine-like anterior (Figs. 5, 78). S7 appearing bare except anteriorly with a pair of tightly clustered thorn-like processes (Figs. 6, 79, 80). Posterior margin of Sg8 truncate or round ..... 16
- Anteclypeus blunt (Figs. 30, 48, 74). S7 with some long and short setae, anteriorly with a pair of loosely clustered setae (Figs. 31, 32, 49, 50, 75, 76). Posterior margin of Sg8 round .... 17
16. Anteclypeus terminating in long slender spine (Fig. 5). S7 with pair of thorn-like processes close to midline, distance between the thorns approximately 2 times their length (Figs. 6, 7). Body colour blackish brown; apt ..... *H. chaweewanae* Sites & Polhemus
- Anteclypeus acute, but not spine-like (Fig. 78). S7 with thorn-like processes distant to midline, distance between the thorns approximately 4 times their length (Figs. 79, 80). Body colour light brown; brpt (or mapt) ..... *H. okinawana* Drake
17. S7 with stronger concave ventral outline in lateral view, and with dispersed long setae ventrally (Figs. 49, 50). Anteclypeus small (Fig. 48); brpt ..... *H. jaczewskii* Lundblad
- S7 with more or less straight ventral outline in lateral view, without dispersed long setae, but with more or less obvious paired patches of short hairs posteriorly. Anteclypeus not obviously small ..... 18
18. S7 in posterior half with well-developed hair patches. Minimum distance of mesocoxae approximately one third of coxa width (Figs. 74-76); apt (or mapt) .. [ *H. mindoroensis* J. Polhemus ] (from northern Borneo eastwards; also key to *H. lombok* Polhemus & Polhemus, from the Lesser Sunda Islands)
- S7 in posterior half with weakly developed hair patches (Figs. 31, 32). Minimum distance of mesocoxae approximately one fifth of coxa width; apt ... *H. cracens* Polhemus & Polhemus
19. Sg8 ending in strong posterolateral corners. Anterior of anteclypeus narrowly rounded, sides of anteclypeus convex (Figs. 60-62); mapt (or brpt) ..... *H. lineata* Eschscholtz
- Sg8 ending in weak posterolateral corners. Anteclypeus with more pointed anterior (Figs. 81-83); mapt (or brpt) ..... *H. orientalis* Lundblad
- Females
20. MTiI > 8. Anteclypeus broad, with parallel sides (Figs. 65, 86), if not, anterior margin weakly convex, blunt or broadly rounded (Fig. 25) ..... 21
- MTiI < 7. Anteclypeus triangular or conical shape, anterior margin strongly convex, narrowly rounded, acute, or spine-like ..... 23
21. Larger species (female 15-18 mm). Sternites medianly distinctly carinate. S7 depressed at posterior half, with some hairs terminally (Fig. 27). Maxillary plates very large (Fig. 26); brpt (or mapt) ..... *H. carinata* Polhemus & Polhemus
- Smaller species (female 12-15 mm). Sternites not carinate or only partly and very faintly carinate. S7 not so modified. Maxillary plates of normal size ..... 22
22. Middle tarsi somewhat longer, MTaI approximately 1.5. T7 strongly raised posteriorly. PT8 directed straight caudad; some specimens with hairy tubercle process at hind margin of pronotum (Figs. 4, 68); brpt (or mapt) ..... *H. longicapitis* Torre-Bueno
- Middle tarsi very short, MTaI approximately 1.2. T7 not raised. PT8 directed ventrocaudad (Fig. 89); apt ..... [ *H. ripicola* Andersen ] (northern Thailand)
23. Anteclypeus anteriorly very acute or spine-like (Figs. 5, 78) ... ..... 24
- Anteclypeus anteriorly blunt or broadly rounded (Figs. 12, 16, 38, 48, 56, 60, 69, 74, 81) ..... 25
24. Anteclypeus terminating in long slender spine (Figs. 5, 8, 9); apt (or mapt) ..... *H. chaweewanae* Sites & Polhemus
- Anteclypeus not terminating in long slender spine (Figs. 10, 11, 78); bra (or mapt) ..... *H. okinawana* Drake
25. Abdomen distinctly upcurved. T7 strongly raised posteriorly. Laterotergites 6 and 7 with numerous long erect hairs (Fig. 51). Anteclypeus very small (Fig. 48); brpt ..... *H. jaczewskii* Lundblad
- Abdomen not so upcurved. T7 not as above or at most slightly raised. Erected hairs on laterotergites 6-7 present or absent. Anteclypeus of normal size ..... 26
26. T7 raised posteriorly with densely set of short hairs (may be rubbed off). PT8 directed ventrocaudad (Figs. 42, 59) ..... 27
- T7 posterior margin not so raised (may raise slightly above laterotergite in smaller species) and without conspicuous hairs. PT8 directed straight caudad or dorsocaudad (Figs. 33, 77) ... ..... 28
27. MTaI approximately 2.4. T7 with denser and longer set of short hairs on posterior margin (Fig. 59). Body colour medium to blackish brown; brpt or mapt ..... *H. kelantan* Polhemus & Polhemus
- MTaI approximately 2.0. T7 with lesser hairs on posterior margin (Fig. 42). Body colour light to medium brown; mapt (or brpt) ..... *H. greeni* Kirkaldy

28. Laterotergites 3-7 with whitish spots in anterior fourth to third (also present, but less distinct, in adjacent areas of sternites). Laterotergites 6-7 with erect long setae (Fig. 33); apt (or mapt) ..... 29
- Laterotergites with continuous whitish or yellowish stripe, or without any obvious markings. Laterotergites 6-7 without erect setae; brpt or mapt ..... 30
29. T5 approximately four times as long as wide. Body colour mainly dark brown (Fig. 33); apt ..... *H. cracens* Polhemus & Polhemus
- T5 approximately three times as long as wide. Body colour mainly light to medium brown (Fig. 77); apt (or mapt) ..... [*H. mindoroensis* J. Polhemus] (from northern Borneo, northwards and eastwards; also key to *H. lombok* Polhemus & Polhemus, from the Lesser Sunda Islands)
30. PT8 curved dorsocaudad (in relation to outline of T8 anteriorly) (Figs. 15, 19, 73) ..... 31
- PT8 pointing straight caudad (in relation to outline of T8 anteriorly) (Figs. 64, 85) ..... 33
31. PT8 shorter than anterior part of T8. S7 with depression on posterior end (Figs. 19, 72, 73) ..... 32
- PT8 in typical specimens as long as or longer than anterior part of T8 (Fig. 15), untypical specimens with short PT8. S7 without posterior depression; mapt or brpt ... [*H. annamana* Hungerford & Evans] (Yunnan, Thailand and Vietnam)
32. S7 posterior end with distinct deep depression (Fig. 19). PT8 more dorsally erected; brpt or mapt.. [*H. borneensis* Zettel & Yang] (Borneo, an allopatric species of *H. maidli*)
- S7 posterior end with shallow depression. PT8 less erected (Figs. 72, 73); mapt or brpt ..... *H. maidli* Hungerford & Evans
33. Anteclypeus narrowly rounded (Fig. 60). Laterotergite 7 posteriorly flapped over T7; posterior margin of T7 approximately half as wide as anterior margin (Figs. 63, 64); mapt or brpt ... [*H. lineata* Eschscholtz] (from northern Borneo northwards and eastwards)
- Anteclypeus with more acute anterior (Fig. 81). Laterotergite 7 posteriorly hardly flapped over T7; posterior margin of T7 approximately as wide as anterior margin (Figs. 84, 85); mapt or brpt ..... *H. orientalis* Lundblad

**NOMENCLATURAL NOTES ON SYNONYMY OF *H. akekawati*, *H. yasumatsui*, and *H. okinawana***

***Hydrometra okinawana* Drake, 1951**

*Hydrometra okinawana* Drake, 1951: 101  
*Hydrometra yasumatsui* Miyamoto, 1964: 214; syn. Polhemus, 1992.  
*Hydrometra okinawana* Polhemus, 1992: 438.  
*Hydrometra akekawati* Sites & Polhemus, 2003: 138, syn.n.

We have compared the characters of paratypes of *H. yasumatsui* Miyamoto, 1964 (in ZRC) and *H. akekawati* Sites & Polhemus, 2003 (in NHMW) and recognized the two taxa as conspecific. According to Polhemus (1992) *H. yasumatsui* is a junior synonym of *H. okinawana* Drake, 1951, therefore *H. okinawana* is the correct name for that species. *Hydrometra okinawana* and *H. yasumatsui* were described from Japan and were unknown from the Oriental fauna and for this reason they are not treated in the revision by Polhemus & Polhemus (1995). Although it apparently is a rare species, we were able to record *H. okinawana* from West Malaysia, Singapore, and Borneo. *Hydrometra akekawati* was described from

northeastern Thailand. Sites & Polhemus (2003) described the “micropterous form” and stated that the brachypterous and macropterous forms are unknown. Because all Oriental species are either monomorphic or have a micropterous/macropterous or brachypterous/macropterous wing dimorphism, this statement may lead to the assumption that *H. akekawati* belongs to that species group, which consists of the (predominantly) micropterous species *H. mindoroensis* Polhemus, 1976, *H. cracens* Polhemus & Polhemus, 1995, and *H. chaweewanae* Sites & Polhemus, 2003. However, using the terminology of Polhemus & Polhemus (1995), the type material of *H. akekawati* is brachypterous: “Mesothoracic wing extending posteriorly to level of anterior end of connexiva.” (Sites & Polhemus, 2003). Therefore, *H. okinawana* (= *yasumatsui* = *akekawati* syn.n.) is eventually more closely related with *H. jaczewskii* Lundblad, 1933.

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Table 1. Distribution of Hydrometridae recorded from Southeast Asia, Sumatra, Java, and Borneo

	Yunnan	Vietnam	Thailand	W/Malaysia	Singapore	Sumatra	Java	Borneo	others
<b>Genus <i>Heterocleptes</i></b>									
<i>H. spinosus</i> Andersen								1	
<b>Genus <i>Hydrometra</i></b>									Taiwan (x); Laos (2); Japan & SE China (3)
1. <i>H. annamana</i> Hungerford & Evans		3	x					x	
2. <i>H. borneensis</i> Zettel & Yang				x	x	x		x	
3. <i>H. brevitarsus</i> Zettel & Yang				x	x	<b>X</b>		x	
4. <i>H. carinata</i> Polhemus & Polhemus			x	<b>X</b>	<b>X</b>			<b>X</b>	
5. <i>H. chaweewanae</i> Sites & Polhemus			x	x	<b>X</b>			x	
6. <i>H. cracens</i> Polhemus & Polhemus			x	x		<b>X</b>		x	
7. <i>H. gilloglyi</i> Polhemus & Polhemus		3	x	x					
8. <i>H. greeni</i> Kirkaldy	x	3	x	x		x			Myanmar, Laos, Andaman I., SE China, Nepal, India, Sri Lanka (x); Bangladesh, Nias (3)
9. <i>H. heoki heoki</i> Zettel & Yang								x	
10. <i>H. heoki paya</i> Zettel & Yang				x					
11. <i>H. jaczewskii</i> Lundblad	<b>X</b>			x		x	4	<b>X</b>	Myanmar (3); SE China (x)
12. <i>H. julieni</i> Hungerford & Evans		3	<b>X</b>	x		<b>X</b>		x	Philippines (x)
13. <i>H. ketantan</i> Polhemus & Polhemus				x					
14. <i>H. lineata</i> Eschscholtz								x	Philippines (x); Ambon, Sulawesi, New Guinea, China (3)
15. <i>H. longicapitis</i> Torre-Bueno	<b>X</b>	<b>X</b>	x	x	x	x	5	x	Laos (x)
16. <i>H. maidli</i> Hungerford & Evans			x	x	x	x	x		Nias, Lombok (x); Sulawesi, Sumba, Sumbawa, Timor (3)
17. <i>H. mindoroensis</i> J. Polhemus								x	Philippines (x); Sulawesi, New Guinea (3)
18. <i>H. okinawana</i> Drake			x	<b>X</b>	<b>X</b>			<b>X</b>	Japan, Taiwan (x)
19. <i>H. orientalis</i> Lundblad	<b>X</b>	3	x	x	x	x	3	x	Cambodia, Laos, Philippines (x); Myanmar, Sulawesi, Sumba, New Guinea, Australia (3)
20. <i>H. ripicola</i> Andersen									

legend:

x : ZRC or NHMW material

**X** : first records, ZRC or NHMW material

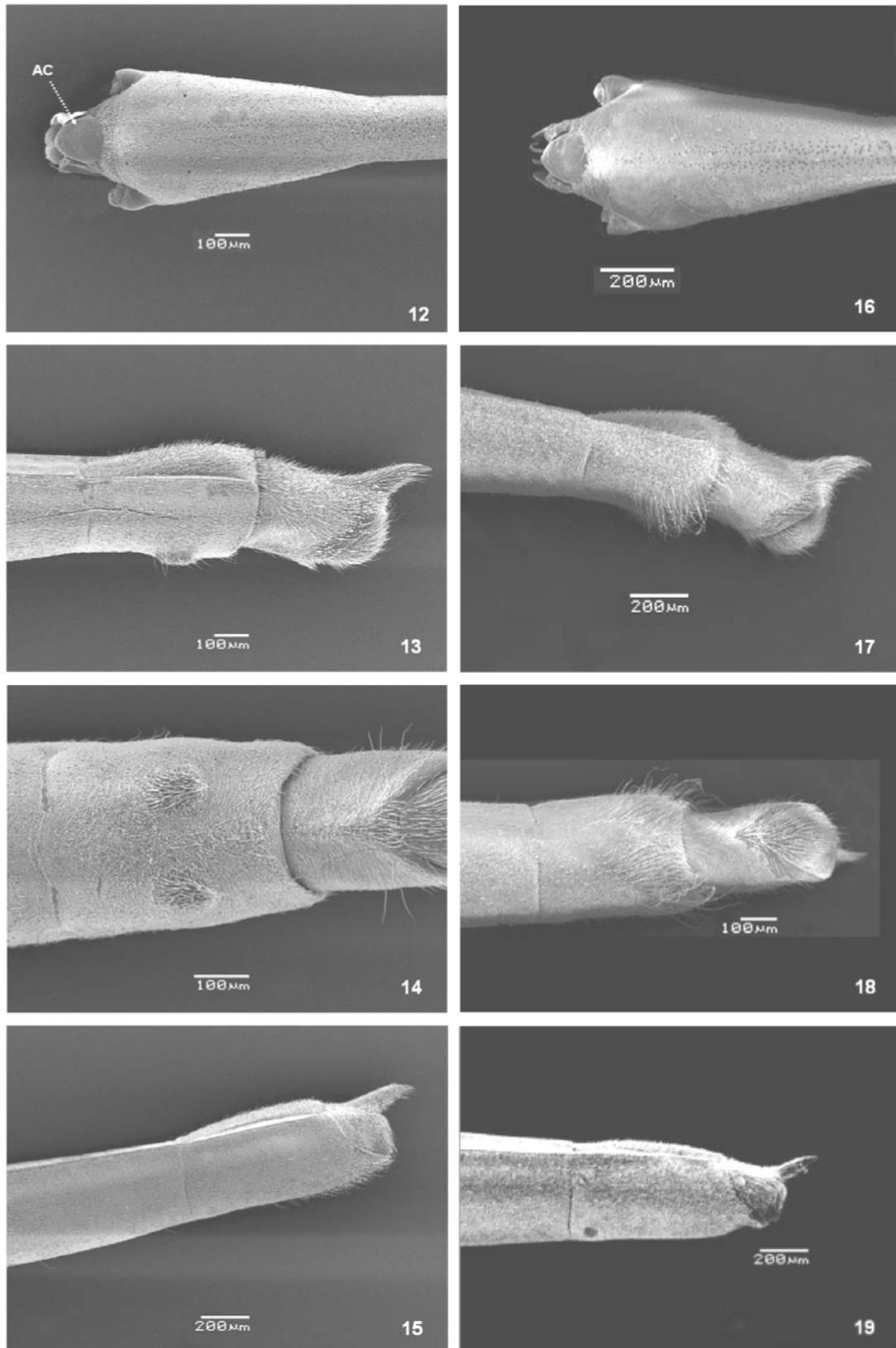
1. Andersen (1982b)

2. Hungerford and Evans (1934)

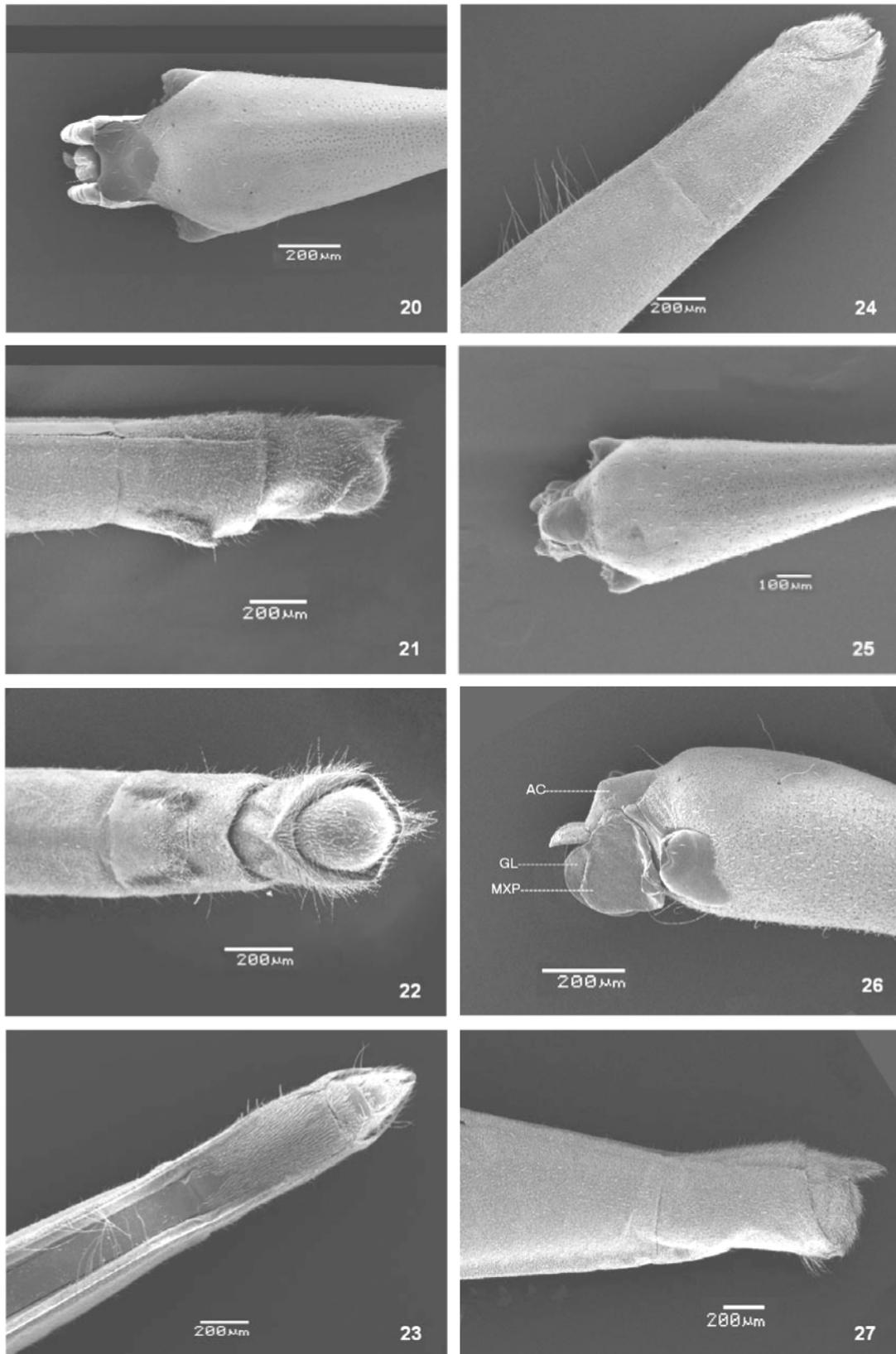
3. Polhemus and Polhemus (1995)

4. Lundblad (1933)

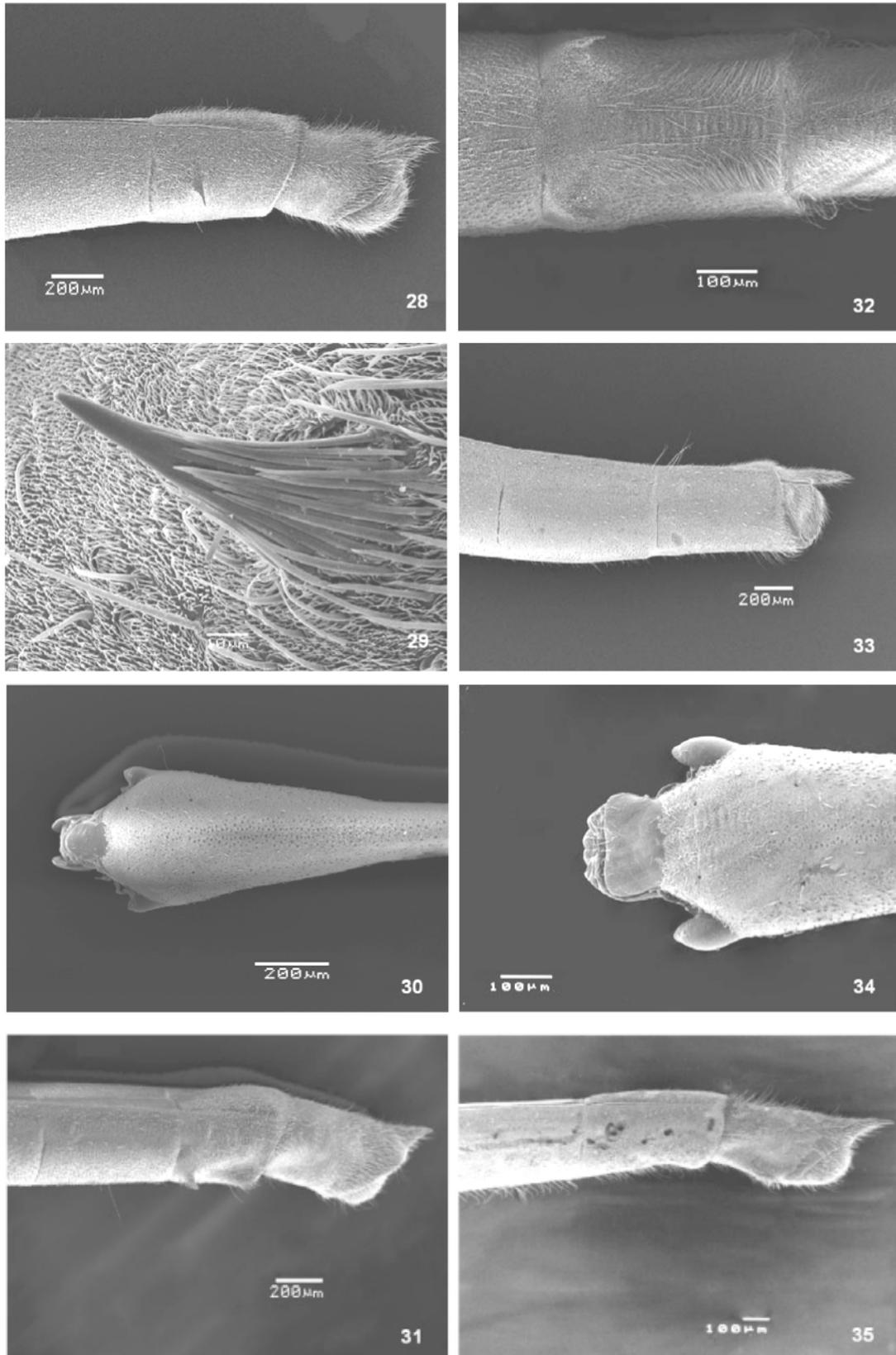
5. Andersen (1992)



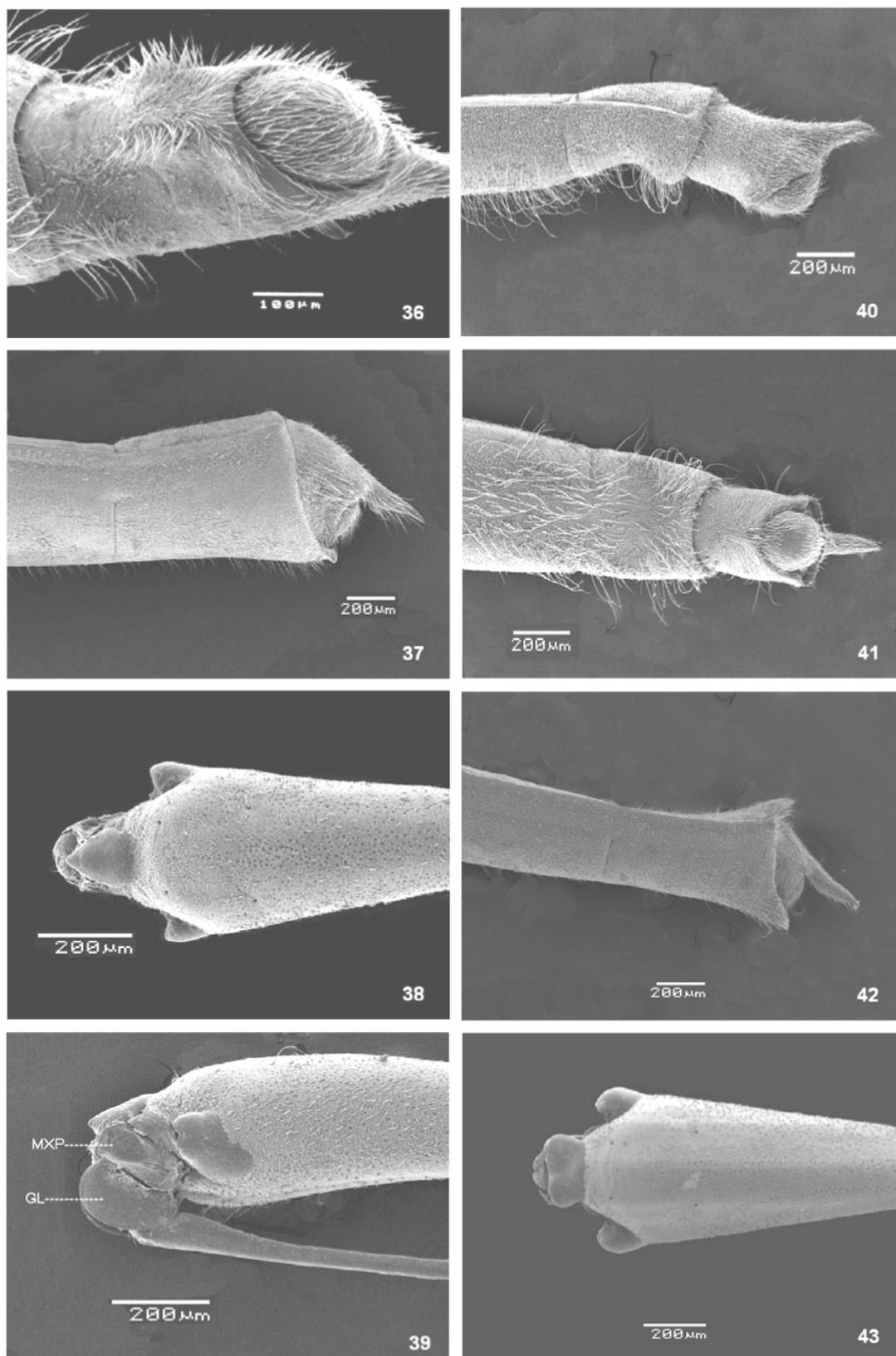
Figs. 12-19: 12-15: *Hydrometa annamana* Hungerford & Evans; 12. Apex of head, dorsal view showing anteclypeus (AC); 13. Male terminal abdomen, lateral view; 14. Male terminal abdomen, ventral view; 15. Female terminal abdomen, lateral view. 16-19: *Hydrometra borneensis* Zettel & Yang; 16. Apex of head, dorsal view showing anteclypeus; 17. Male terminal abdomen, lateral view; 18. Male terminal abdomen, ventral view; 19. Female terminal abdomen, lateral view.



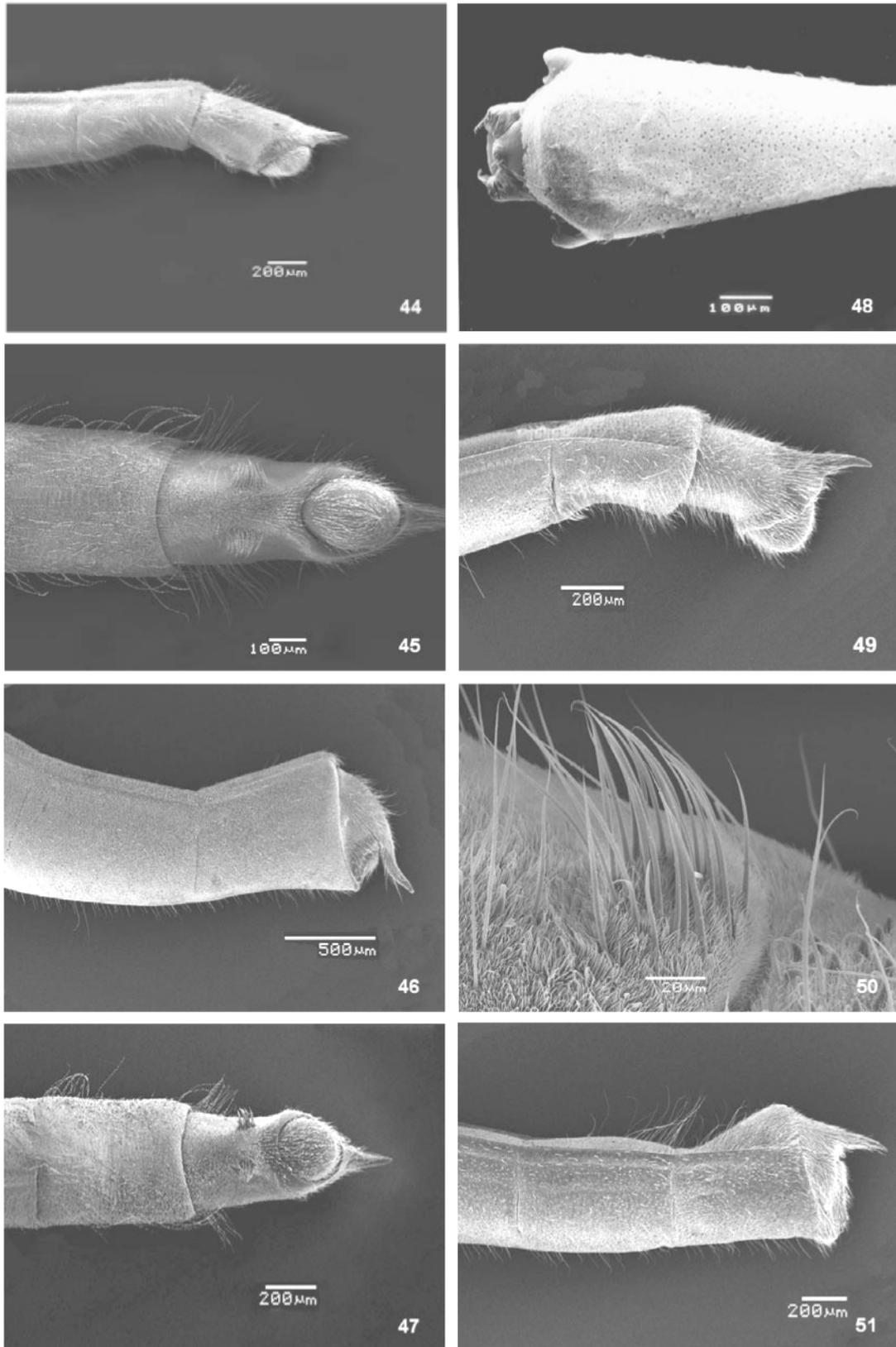
Figs. 20-27: 20-24: *Hydrometra brevitarsus* Zettl & Yang; 20. Apex of head, dorsal view showing anteclypeus; 21. Male terminal abdomen, lateral view; 22. Male terminal abdomen, ventral view; 23. Female terminal abdomen, dorsal view; 24. Female terminal abdomen, lateral view. 25-27: *Hydrometra carinata* Polhemus & Polhemus; 25. Apex of head, dorsal view showing anteclypeus; 26. Head, lateral view (AC, anteclypeus; GL, gular lobe; MXP, maxillary plate); 27. Female terminal abdomen, lateral view.



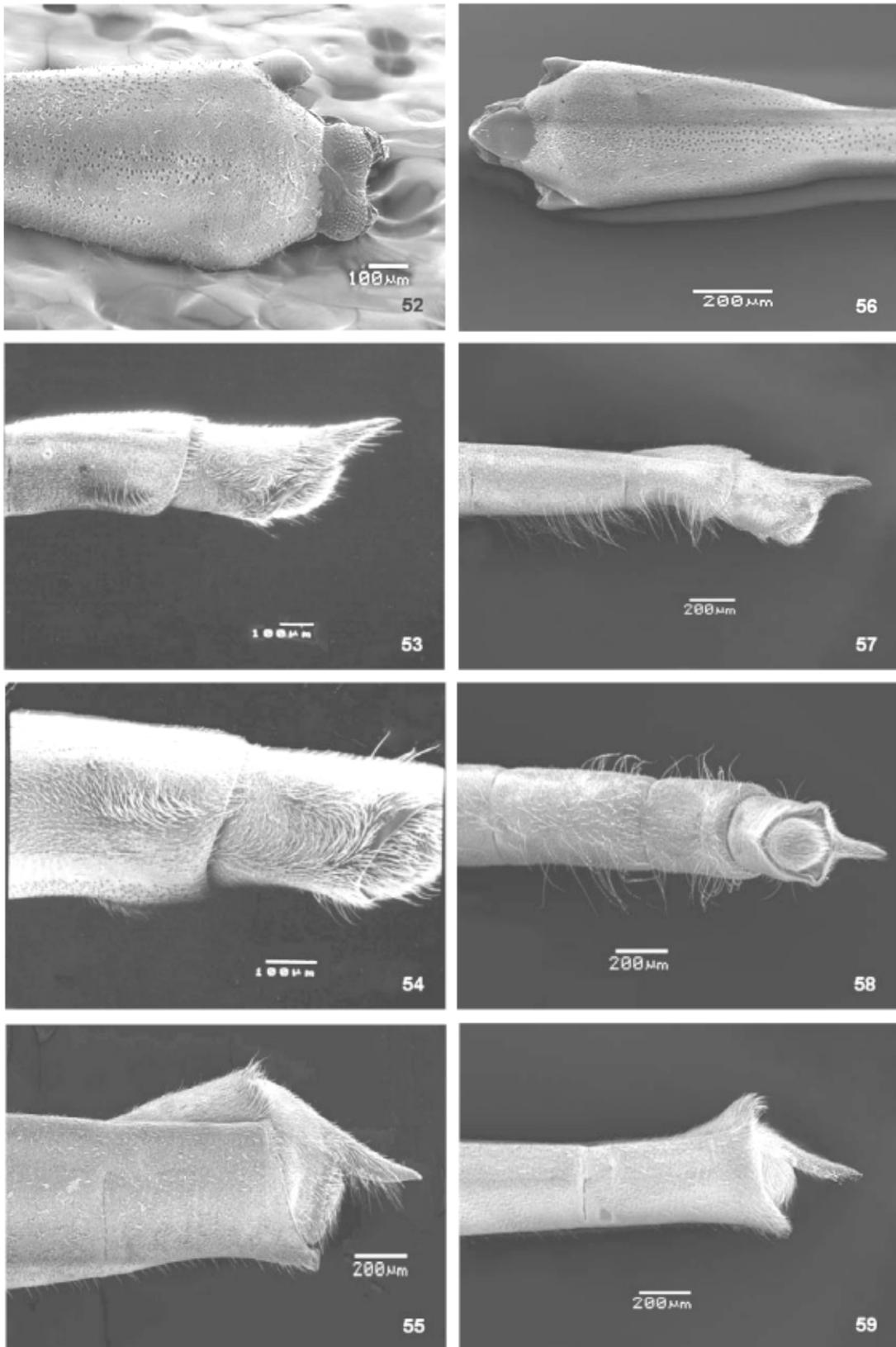
Figs. 28-35: 28-29: *Hydrometra carinata* Polhemus & Polhemus, male terminal abdomen; 28. lateral view; 29. cluster of spines on sternite 7. 30-33: *Hydrometra cracens* Polhemus & Polhemus; 30. Apex of head, dorsal view showing anteclypeus; 31. Male terminal abdomen, lateral view; 32. Male terminal abdomen, ventral view; 33. Female terminal abdomen, lateral view. 34-35: *Hydrometra gilloglyi* Polhemus & Polhemus; 34. Apex of head, dorsal view showing anteclypeus; 35. Male terminal abdomen, lateral view.



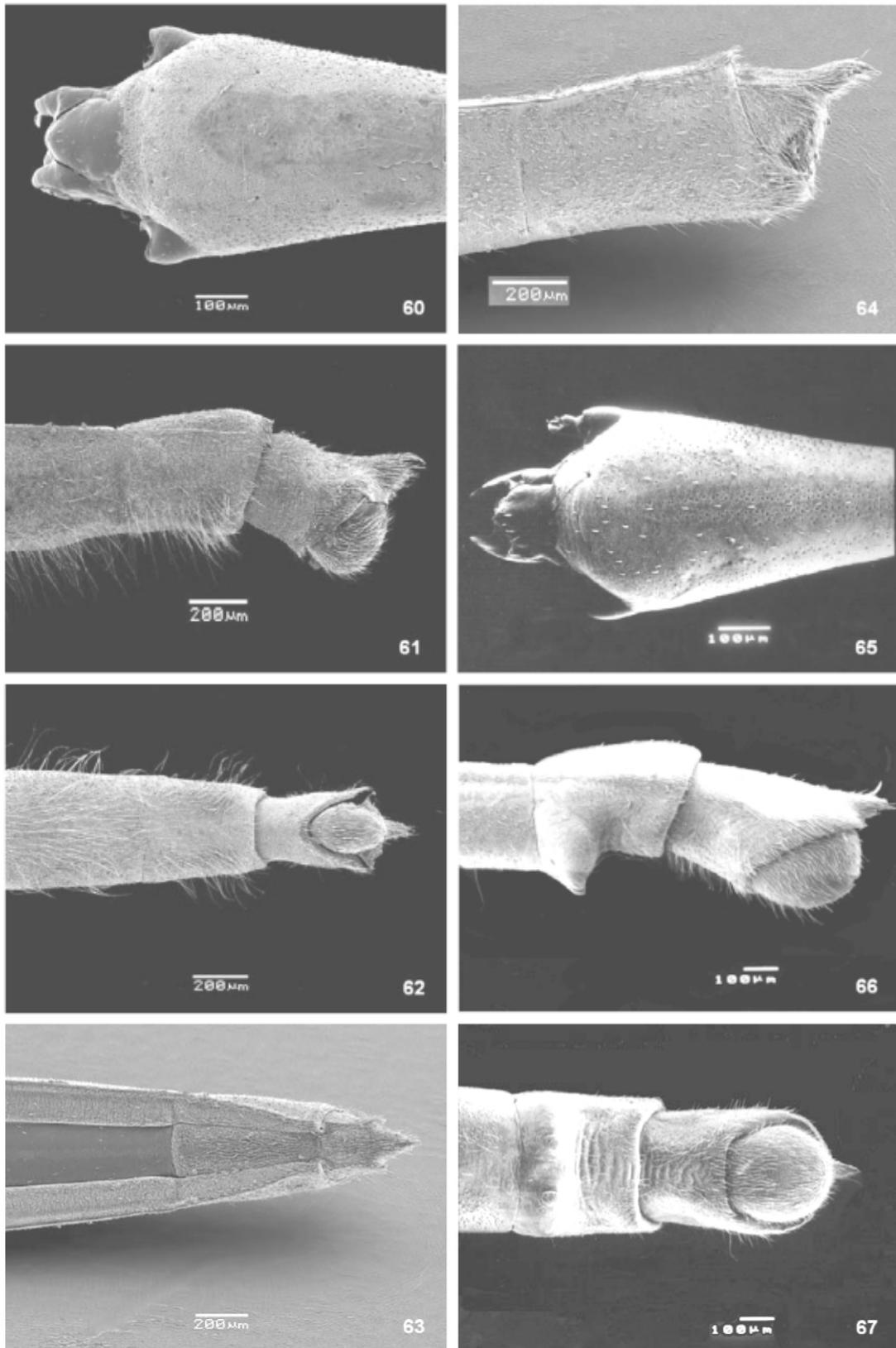
Figs. 36-43: 36-37: *Hydrometra gilloglyi* Polhemus & Polhemus; 36. Male terminal abdomen, ventral view; 37. Female terminal abdomen, lateral view, note the posterior-median protrusion of sternite 7. 38-42: *Hydrometra greeni* Kirkaldy; 38. Apex of head, dorsal view showing anteclypeus; 39. Head, lateral view (GL, gular lobe; MXP, maxillary plate); 40. Male terminal abdomen, lateral view; 41. Male terminal abdomen, ventral view; 42. Female terminal abdomen, lateral view; 43. *Hydrometra heoki heoki* Zettel & Yang, apex of head, dorsal view showing anteclypeus.



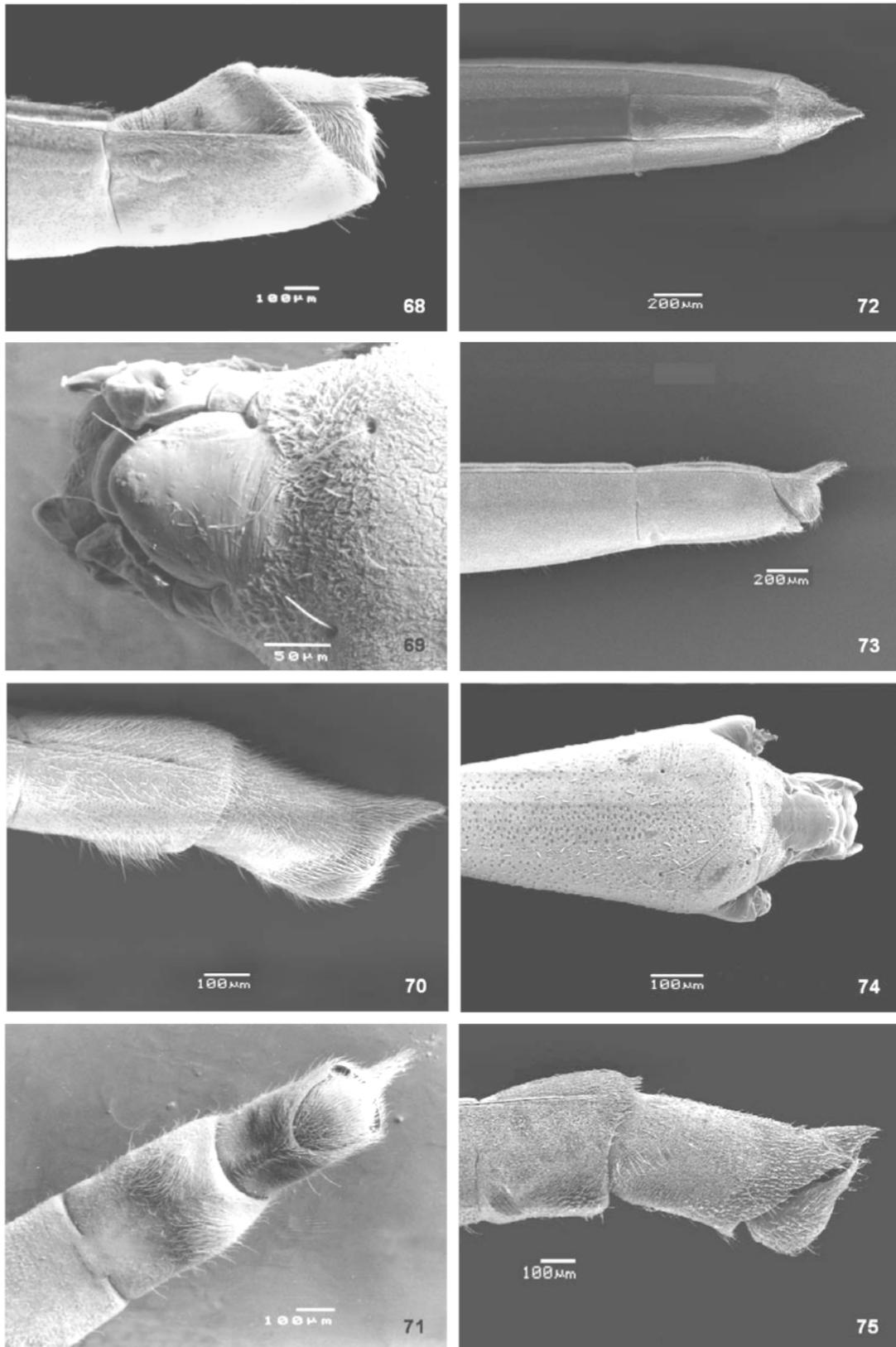
Figs. 44-51: 44-46: *Hydrometra heoki heoki* Zettel & Yang; 44. Male terminal abdomen, lateral view; 45. Male terminal abdomen, ventral view; 46. Female terminal abdomen, lateral view; 47. *Hydrometra heoki paya* Zettel & Yang, male terminal abdomen, ventral view; 48-51: *Hydrometra jaczewskii* Lundblad. 48. Apex of head, dorsal view showing anteclypeus; 49. Male terminal abdomen, lateral view; 50. Male, cluster of setae on sternite 7; 51. Female terminal abdomen, lateral view.



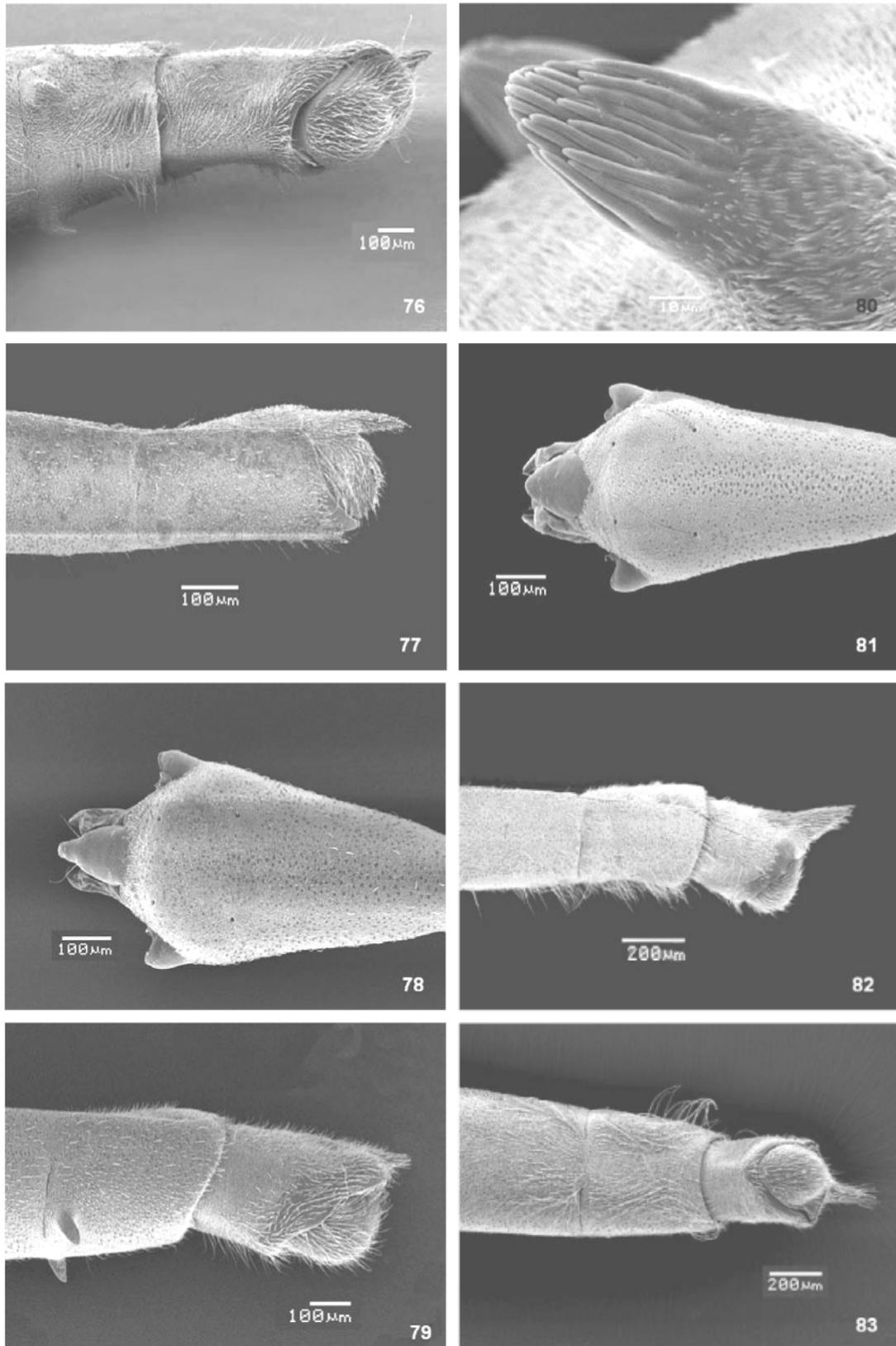
Figs. 52-59: 52-55: *Hydrometra julienei* Hungerford & Evens; 52 Apex of head, dorsal view showing anteclypeus; 53. Male terminal abdomen, lateral view; 54. Male terminal abdomen, ventral view; 55. Female terminal abdomen, lateral view. 56-59: *Hydrometra kelantan* Polhemus & Polhemus; 56. Apex of head, dorsal view showing anteclypeus; 57. Male terminal abdomen, lateral view; 58. Male terminal abdomen, ventral view; 59. Female terminal abdomen, lateral view.



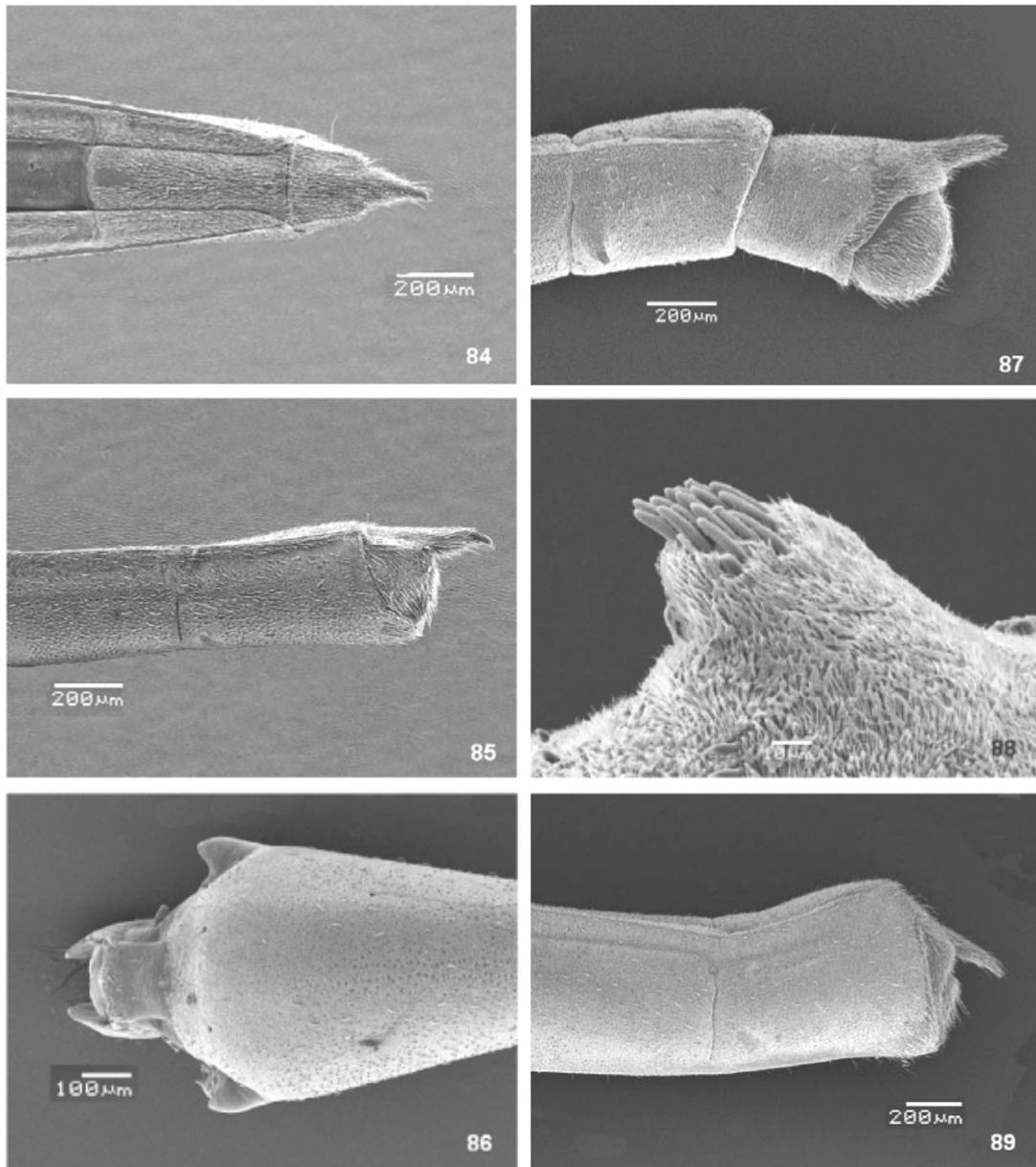
Figs. 60-67: 60-64: *Hydrometra lineata* Eschscholtz; 60. Apex of head, dorsal view showing anteclypeus; 61. Male terminal abdomen, lateral view; 62. Male terminal abdomen, ventral view; 63. Female terminal abdomen, dorsal view; 64. Female terminal abdomen, lateral view. 65-67: *Hydrometra longicapitis* Torre-Bueno; 65. Apex of head, dorsal view showing anteclypeus; 66. Male terminal abdomen, lateral view; 67. Male terminal abdomen, ventral view.



Figs. 68-75: 68. *Hydrometra longicapitis* Torre-Bueno, female terminal abdomen, lateral view. 69-73: *Hydrometra maidli* Hungerford & Evans; 69. Apex of head, dorsal view showing anteclypeus; 70. Male terminal abdomen, lateral view; 71. Male terminal abdomen, ventral view; 72. Female terminal abdomen, dorsal view; 73. Female terminal abdomen, lateral view. 74-75: *Hydrometra mindoroensis* J. Polhemus; 74. Apex of head, dorsal view showing anteclypeus; 75. Male terminal abdomen, lateral view.



Figs. 76-83: 76-77: *Hydrometra mindoroensis* J. Polhemus; 76. Male terminal abdomen, ventral view; 77. Female terminal abdomen, lateral view. 78-80: *Hydrometra okinawana* Drake; 78. Apex of head, dorsal view showing anteclypeus; 79. Male terminal abdomen, lateral view. 80. Male, cluster of tightly thorns on sternite 7; 81-83: *Hydrometra orientalis* Lundblad; 81. Apex of head, dorsal view showing anteclypeus. 82. Male terminal abdomen, lateral view; 83. Male terminal abdomen, ventral view.



Figs. 84-89: 84-85: *Hydrometra orientalis* Lundblad, female terminal abdomen; 84. Dorsal view; 85. Lateral view. 86-89: *Hydrometra ripicola* Andersen; 86. Apex of head, dorsal view showing anteclypeus; 87. Male terminal abdomen, lateral view; 88. Male, cluster of thorns on the hump of sternite 7; 89. Female terminal abdomen, lateral view.