

BRAUERIA (Lunz am See) 18: 5 - 8 (1991)

**CADDISFLIES OF THE GENUS HYDRONEMA IN THE USSR (HYDROPSYCHIDAE)**

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**ABSTRACT.** Caddisflies of the genus Hydrone-ma Martynov, 1914, are reviewed; synonymy of H.persica Martynov, 1914, and H.rudolfi Mey, 1986, is proposed. The genus Hydrone-ma is monotypic and inhabits the high mountains of Central Asia. The taxonomic position of this genus is enigmatic, the single species has the characters both of Macronematinae and Hydropsychinae. Lectotype and paralectotypes of H.persica Mart. are designated and illustrated, immature stages are described, biology and distribution of this species in the USSR are reviewed.

**INTRODUCTION**

The genus Hydrone-ma (Hydropsychidae) was described in 1914 by A.V.Martynov; the single species of the genus was named persica, for it was supposed that the material was collected in Persia (Iran) by Zarudny. This genus is unusual for the amount of misunderstandings over its description and composition, as well as for the uncertainty of its taxonomic position within Hydropsychidae. A.V.Martynov (1934) claimed that the genus is close to the group Cheumatopsyche processuata - amurensis, but has some features of the subfamily Macronematinae. Short discoidal cell, absence of hairs on the fore wings, and reduction of palps seem to be the features typical for Macronematinae, but modified male tarsal claws and rather short antennae show clear hydropsychine affinities. The genus inhabits mountain regions of Central Asia which is interesting because it could be the link between Hydropsychinae and Macronematinae. The immatures were unknown until now.

The original description of the genus and species appears to be misleading: in later publication (Martynov, 1917) several mistakes were corrected. Firstly, the type localities of the species are situated in Turkestan instead of Persia; secondly the place of origin was incorrect: the material was collected in "Pekeli, Temirsai" and not "Pekli, Tiparsai"; thirdly, the date of collection in Temirsai should be 23.06.1907 instead 28.07.1907. Finally, the distribution was indicated by Martynov (1934:294) as "Turkestan: river Pskem, Temirsai, Khumsan".

Additional material of this genus was collected in Hindukush and Badakshan Mountains by Schmid (1958), Klapperich (Schmid, 1963), and Naumann (Malicky, 1986). Another member of the genus was described recently by W.Mey (1986) as H.rudolfi Mey; a single male specimen was collected by R.Jung in the Hissar Mountains, North Tadzhikistan (USSR). The material from Afghanistan referred to as H.persica was claimed by Mey (1986) to be H.rudolfi.

Differences between both species, H.persica and H.rudolfi, were so small that one might suspect the synonymy of these two species. Another slip appeared to be critical for description of the Hissar specimen as a distinct species: Genitalia of H.persica were studied and illustrated by Malicky (1983) as having wide basal segments of the inferior appendages with roughly serrated dorsal surfaces, and rounded apical segments of these appendages. Genitalia of a syntype specimen studied by Malicky were treated in KOH and were slightly damaged during this treatment: the swelling matrix within the basal segment

of the inferior appendages broke the thin cuticle on the dorsal surface of the gonopods, and the broken edges directed upwards were illustrated as being the dorsal surface of the gonopods. Unfortunately, this drawing was the only material for comparison with H.rudolfi. Finally, Mey (1986) admitted that H.persica was described from Iran, and the new species, H.rudolfi, belongs to a different zoogeographical region; these two species supposed to be sister-taxa showed geographical vicariance.

Additional specimens collected by Dr.L.A. Zhiltzova in Pamir and the Tian-Shan Mountains, and by the author in Pamir were used to clarify the problems concerning the genus Hydrone-ma. Redescription of the genus and type species is not necessary, but the lectotype designation and some remarks should be added to Martynov's descriptions cited above. The immatures of Hydrone-ma, and some behavioural features are described. The status of H.rudolfi is clarified by using new material.

**MATERIAL AND METHODS**

Pinned types of H.persica were studied using short-time treatment of genitalia in KOH. The additional data on the Zarudny expedition (type localities) given in parentheses were found in the letter of L.Lindknecht to E.Tetujeva, deposited in the files of the Zoological Institute in Leningrad. Dates of collecting should be changed according to the Gregorian calendar which differs by 13 days from the old Julian calendar used in Russia before 1918. Immature stages are described according to the association of pupae and larvae collected nearly in the same place, after examination of larval exuviae. All material mentioned is deposited in the Zoological Institute, Leningrad. Pinned adults were collected by N.Zarudny, and L.A.Zhiltsova in 1966; all other material is stored in alcohol.

**Hydrone-ma persica Martynov, 1914**

Annu.Zool.Mus.Acad.Sci.(Russia) 19:126-129, figs. 1-4.

Lectotype, male: (West Tian-Shan, Talas Alatau Mts., river Ugam,) Khumsan, 27.06.1907 (new Gregorian date: 10.07.1907), Zarudny. -

Paralectotypes: 2♂♂, data as for lectotype; 1♂, 1♀: (West Tian-Shan, Talas Alatau Mts.,) River Pskem, Tiparsai (instead Temirsai; according to the label), 23.06.1907 (new date: 6.07.1907), Zarudny. - It should be noted that the names "Khumsan" and "Tiparsai" are absent on modern maps.

Other material studied: 1♂, Pamir, Khorog, River Shahdara, 20.07.1969, L.Zhiltsova; 1♂, Pamir, River Shahdara, kishlak Andzhin, 25.07.1969, L.Zhiltsova; 1♀, Pamir, kishlak (village) Dzhelandy, River Tokuzbulak, 2.07.1971, L.Zhiltsova; 1♀, Fergana, River Tar, 22-29.07.1910, V.Malutin; 3♂♂, 1♀, Tian-Shan, River Tchu, 7 km NE Kochkorka, 7.07.1966, L.Zhiltsova; 1♀, Pamir, vic. Khorog, 21.08-10.09.1988, N.Kluge; 4♂♂, 1♀, Pamir, Ishkashim, at light, 16.08.1988, Ivanov; 29♂♂, 52♀♀, at the same place, 17.08.1988, Ivanov; 6♂♂, 15♀♀, at the same place, 18.08.1988, Ivanov; 7♂♂, Pamir, Goran, River Pyandzh, kishlak Nishusp, on stones, 15.08.1988, Ivanov.

Larvae: 7 mature, West Pamir, vic. Khorog, kishlak Nivodak, River Pyandzh, 26.05.1990, Ivanov; 4 young, at the same place, 25.08.1988, Ivanov; 10 mature, Central Pamir, River Alichur near kishlak Alichur, at the bridge, 22.08.1988, Ivanov.

Pupae: 1♂, 2♀♀, Pamir, Khorog, River Gunt, 14.08.1988, Ivanov.

## MORPHOLOGY AND TAXONOMY

Genitalia of the male type specimens (lectotype and paralectotype) are shown in figs. 1-8. Small asymmetry is visible on segment X of the lectotype: terminal processes have different orientation, and this segment is slightly distorted. Inferior appendages are normally turned dorsad. Genitalia of lectotype were illustrated in the descriptions by A.V.Martynov; that of paralectotype were shown on the drawings in Malicky (1983:107) referred to by Mey (1986). Orientation of the genitalia affects the visible proportions (Malicky, 1988); thus, the apical parts of raised inferior appendages look very wide in the dorsal views shown in Martynov (1914) and Malicky (1983) in relation to the length of these parts; posterior view (fig.6) shows these structures much more slender and elongated. They have dorsomedial areas of desclerotization at the ends. The apical segment of the inferior appendages was shown by Martynov (1914, 1934) to be cut at the end. Contrary to Martynov's descriptions, the aedeagus is not thin. Living adults have a very characteristic appearance, with their whitish wings, blackish heads and thoraxes covered by a thin wax layer.

Variations in the material studied were very prominent. The uncertain number of fore tibial spurs was mentioned by Martynov as "(1)"; fore leg spurs are short, "tuberculus-like" (Martynov 1934:294), and sometimes absent. The same appears to be true for the hind tibial spurs of Pamir material: basic number seems to be 4, but all variants to 2 were observed. Sometimes the same specimen had one hind leg with 4 and the other with 2 spurs. Some specimens in the same population (Ishkashim) had processes of segment X more slender than in the type specimens, and the basal segment of the inferior appendages slender and cut at the apex. Variations of the apical part of the aedeagus were also observed: inferior apical lobe is usually longer than apical dorsal lobe, but sometimes it is about half the length of the dorsal structures. In the type specimens, these inferior lobes are short. Appearance of the apical processes of segment X depends of their shape and orientation; sometimes small additional subapical teeth are visible on the processes in question. Discoidal cell is variable in fore wings, sometimes it is open in fore as well as in hind wings. Apical part of CuP is separated often from the following vein apex at the fore-wing margin.

The comparison of *H.rudolfi* and *H.persica*, including the range of variations and differences in proportions caused by orientation, confirms the identity of these two species. The main diagnostic feature, the shape of the inferior appendages, is the same in both species. Other distinctions appear to be within the range of variation. Thus, *H.rudolfi* Mey 1986 should be recognised as the junior synonym of *H.persica* Martynov 1914.

Female genital structures of this species have not been described before. Female terminalia are very characteristic, they are shown on fig.9. Large cavities on the sides of segment IX seems to accept the enlarged apical parts of basal segments of the male inferior appendages during copulation.

Antennal and postocular head warts are reduced in both sexes, and there are prominent protuberances between the antennae bearing frontal warts, especially in the males (figs.10,11). The considerable reduction of head occipital warts and medial

pronotal warts is noticeable in females. Sexual dimorphism is most prominent in the antennae: those of males are longer than the body, with very thin segments. Antennae of females are very short, not reaching further than the middle of the fore wing, since the terminal segments of female antennae are shortened. The degree of development of palps is different in both sexes and corresponds to that of the antennae.

## PUPAE

Pupal shelter is usual for Hydropsychinae, being constructed from particles of sand roughly fastened together, with a silken transparent underlayer. Pupae show the same sexual dimorphism as imagines, both in antennae and in palps. Anal protuberances are stout, with terminal notches (fig. 19). Wing vestiges are slender, whitish in the mature pupa. Structures of dentate locking sclerites of the pupae are characteristic (fig. 21): there are tiny rounded fore segmental plates on segments II - VIII, one pair of elongated transverse hind segmental plates on segment III, and a pair of reduced such plates on segment IV. General coloration of the mature pupae is dark brown except for the lighter wings and abdominal pleura. Pupal mandibles are well developed (fig. 20).

## LARVAE

Structures of mature (figs. 12 - 18) and immature larvae are similar. Length up to 17 mm. Head short, rounded, blackish-brown with light spots around the eyes, and light brown pattern on the frontoclypeus. Dorsal sclerites on pro- and mesonotum dark brown, on metanotum light brown; legs, ventral and lateral thoracic sclerites brownish. Mandibles asymmetrical, left one with the teeth at the apex only. The area of transverse stridulatory ridges on the head is long and narrowed behind. A pair of very large subdivided posterior prothoracic sclerites and forked prothoracic trochantin show hydropsychinae affinities, as well as the structure of abdominal gills and prolegs. Ventral sclerotizations on segment IX with caudal incisions. Chaetotaxy is very distinct: dense long whitish pubescence on dorsolateral parts of the head and very short pubescence on the mesonotum; short stout obtuse cylindrical spines on head and dorsal thoracic sclerites. Long normal setae are not numerous. Abdominal chaetotaxy: long flattened pointed setae on all parts of segments and short small triangular scales with serrated wide apexes on tergal parts. Branches of the abdominal gills tend to form pectens on the external surfaces. Structure of legs as in Hydropsychinae. Retreats are normal for Hydropsychinae.

## BIOLOGY

The larvae of these insects live in the large rivers on high mountain on stony bottoms in turbulent parts of the flow at heights from 1150m (Schmid 1963) to 3600m (Alichur). Adults were observed in flight near the shore of River Pyandzh, where males sometimes flew close to the water near large stones at midday. The main activity of these caddisflies begins after sunset; in complete darkness, males and females are attracted by light sources, but the flight activity period is very short and finishes before midnight. The flight season seems to be extremely short; emergence take place at different periods according to the weather, altitude, and geographical position. In Pamir, adults were observed by the author during four days, but the main activity seemed to be on one night only. Such short periods of emergence make these insects rare in collections.

Adults were not active after arrival at the light source. The species seems to be univoltine, with late summer emergence at higher altitudes.

#### PHYLOGENY

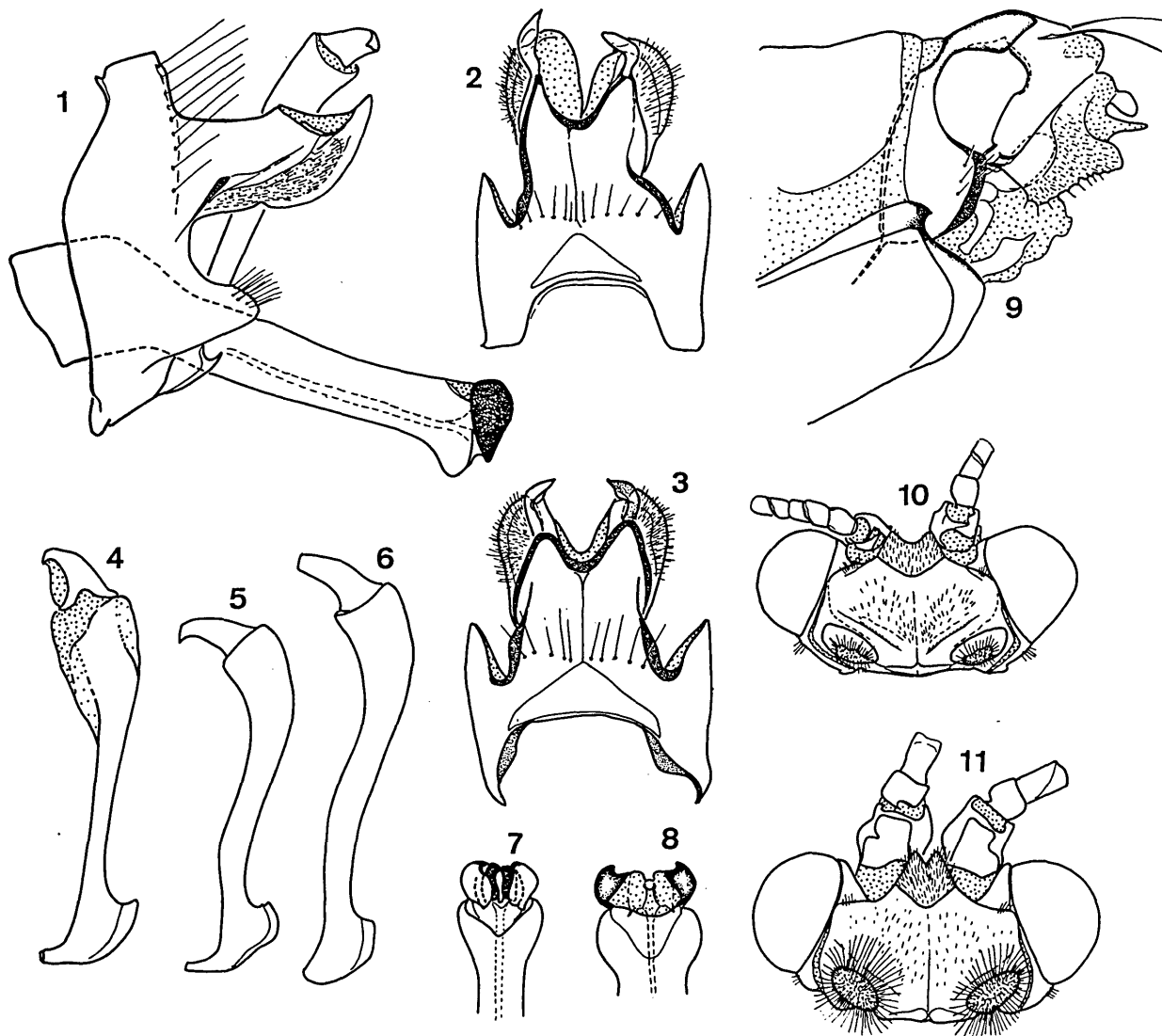
The phylogenetic position of the genus *Hydronema* is enigmatic. There is a mixture of hydropsychine and macronematine characters indicating the possible intermediate position of this genus. The supposed macronematine features are as follows:

1. Reduction of maxillary and labial palps, especially in females.
2. ? Antennae are thin and long in males, but much shorter in females.
3. Very thin pale wings with reduced, rare, easily shed surface hairs.
4. Prominent pale long pterostigma on the fore wings.
5. Transverse line of wing tip flexion on the fore wings.
6. Tendency to reduction of DC on both fore and hind wings.
7. Slender basal parts of Cu and PCu veins on fore wings.
8. Prominent locking fold in the postcostal field of fore wing and developed wing locking setae on the fore margins of hind wing.
9. Shortened and curved 3rd pteralia of the hind wing articulations.
10. Reductions of spurs on tibiae.

The hydropsychine features are as follows:

1. Male tarsi with brushes of hairs instead of outer claws.
2. Fore wings with row of setae along PCu on the inner surface.
3. Slender costal and postcostal fields of fore wing.
4. Relatively short mesoscutellum.
5. Long parapsid sutures on the mesonotum.
6. Genital structures resemble *Cheumatopsyche processuata* Mart. and related species, as suggested by Martynov (1934).
7. Larval fore trochantin forked.
8. Four anal vesicles in larvae.
9. Larval chaetotaxy with abdominal scales.
10. General appearance and retreats of larvae and pupae as in Hydropsychinae.
11. Anal protuberances of the pupae with apical notches.
12. Pupal mandibles well developed.
13. Antennae of pupae never wound around the abdomen.

The taxonomic significance of these features and plesiomorph/apomorph conditions are not clear. The genus *Hydronema* was included by Martynov (1934) in Hydropsychinae, and the immature stages confirm this position. Head warts, wings, and wing articulations have peculiar structures showing evolutionary trends to Macronematinae, but these structures are not decisive in treating this genus as an intermediate taxon.



*Hydronema* is a true Central Asian genus inhabiting Pamir, Hissaro-Alai, Hindukush, Badakshan, and Tian-Shan mountain systems. There could be some other members of this genus in the mountain regions of West China. The determination of the position of this genus in the family Hydropsychidae requires extensive comparative investigations.

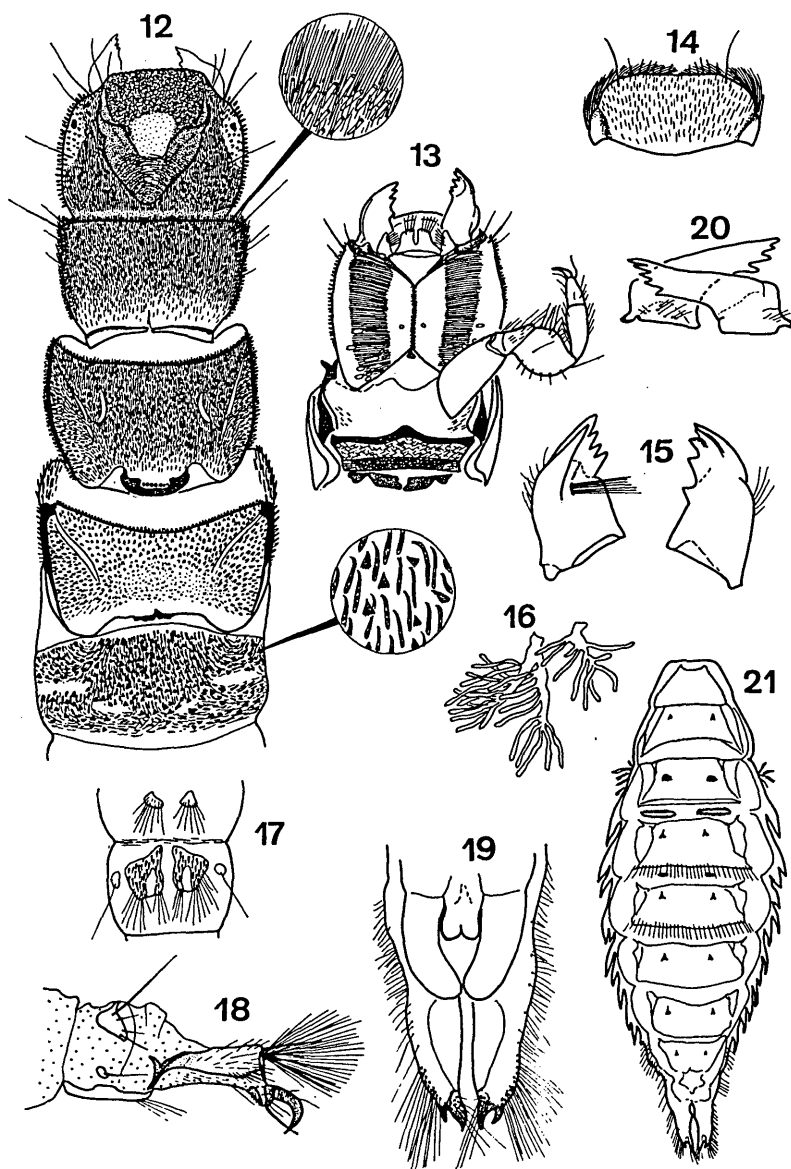
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- Fig.1. Male genitalia of *Hydronema persica*, lectotype: lateral view, left inferior appendage omitted.  
 Fig.2. The same: segments IX-X, dorsal view.  
 Fig.3. Paralectotype, male: segments IX-X, dorsal view.  
 Fig.4. The same: left inferior appendage, dorsal view showing broken area.  
 Fig.5. Lectotype, right inferior appendage: ventral view.  
 Fig.6. The same: caudal view.  
 Fig.7. Lectotype, aedeagus: dorsal view of the apex.  
 Fig.8. The same: ventral view.  
 Fig.9. Female paralectotype, genitalia, lateral view.  
 Fig.10. Female, head: dorsal view.  
 Fig.11. Male, head: dorsal view.  
 Fig.12. Mature larva, head, thorax and 1st abdominal segment: dorsal view, surface microstructures are shown separately.  
 Fig.13. Larva, head and prothorax: ventral view.  
 Fig.14. Larva, labrum: dorsal view.  
 Fig.15. Larva, mandibles: dorsal view.  
 Fig.16. Larva, right ventral abdominal gill: caudal view.  
 Fig.17. Larva, abdominal segment X: ventral view.  
 Fig.18. Larva, anal proleg: lateral view.  
 Fig.19. Pupa, end of abdomen: ventral view.  
 Fig.20. Pupa, right and left mandibles: dorsal view.  
 Fig.21. Pupa, abdomen: dorsal view.



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Zeitschrift/Journal: [Braueria](#)

Jahr/Year: 1991

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Autor(en)/Author(s): Ivanov Vladimir D.

Artikel/Article: [Caddisflies of the genus Hydroneura in the USSR \(Hydropsychidae\) 5-8](#)