

Commented checklist of mayflies (Ephemeroptera) of Mongolia

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The checklist of Mongolian Ephemeroptera now contains 96 species in 34 genera and 14 families. Based on extensive material collected in July 2005, *Ameletus cedrensis*, *Siphonurus palaeartcticus*, *Siphonurus zhelochovtsevi*, *Acanthametropus nikolskyi*, *Baetis atrebatinus*, *Afronurus abracadabrus*, *Afronurus levis*, *Sparbarus corniger*, and *Caenis macronyx* are recorded for the first time, in addition to more than 50 new regional records. Literature sources of individual records (including those of preliminary determinations), unambiguous synonyms, taxonomic shifts, some changes of nomenclature and distribution from the chorological point of view are discussed. The Mongolian mayfly fauna consists of large area species (about 1%), Holarctic species (about 12%), Palaeartic species (about 22%), East Palaeartic species (about 60%) and East Palaeartic species so far found only in insufficiently known regions of Mongolia (about 5%).

Keywords: Ephemeroptera; Mongolia; checklist; synonymy; species new to area; distribution

Introduction

Subsequent records on Mongolian mayflies were based on material collected by expeditions. Among others, these were the Hungarian–Mongolian expedition (mayflies collected by Z. Kaszab in 1964, 1965, 1966, and 1968), the Soviet–Mongolian joint expeditions in 1970–1980 (Kozhova et al. 1977; Erbaeva et al. 1977, 1986) and the Mongolian–German expedition (mayflies collected by M. Stubbe and K. Gunther in 1962, 1964, and 1977).

In 1995, the Academy of Natural Sciences (USA) began collaboration with the National University of Mongolia and the Mongolian Academy of Sciences in joint biodiversity research expeditions in the Hovsgol (Khubsugul) Nuur [lake] watershed. The material from 1995–1997 was collected by J. Morse, J. Gelhaus, B. Hayford, A. Prather, E. Hunter, B. Namkhaidorj, and C. Goulden and identified by T. Soldán in 2001 and 2004. S. Enkhtaivan collected further larvae and adults during May–September, 2002–2003 at 61 localities from this area. Altogether 56 species have been

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determined, 26 of these representing new records for Mongolia (Enktaivan and Soldán 2008).

The main objective of this paper is to (1) summarise all available literature data on the occurrence of mayflies in Mongolia, (2) present their unambiguous synonyms, (3) determine the material collected in July 2005 in the Selenge River basin with a special reference to species new to the Mongolian fauna and new local records, (4) discuss controversial findings and taxa and analyse the Mongolian mayfly fauna from a chorological point of view.

Results and discussion

At the end of the 1970s, the checklist of Mongolian Ephemeroptera contained only 38 species, and another 20–25 species were collected until the end of the twentieth century (Braasch 1982, 1986; Landa and Soldán 1983; Enktaivan and Soldán 2008). At present, it contains altogether 96 species in 34 genera and 14 families (Table 1). Formally, the monotypic family Acanthametropodidae is recorded from Mongolia for the first time. Larvae were collected at several localities in the Bulgan, Hovsgol and Selenge Aimag (leg. S. Enktaivan and T. Soldán, July 2005) but respective material was collected near Ulaanbaatar as early as in the 1980s (Kluge, personal communication). Similarly, the recently erected genus *Sparbarus* Sun et McCafferty, 2008 of the family Caenidae (Brachycercinae) is newly recorded from Mongolia based on new findings of larvae of *S. corniger*. However, *S. tubulatus* was found in the Selenge Aimag a good many years ago (Bajkova and Varychanova 1978, sub *Brachycercus*). The finding of subgenus/genus *Labiobaetis* new to the Mongolian fauna depends on the taxonomic concept of the genus *Baetis* s.str./s.lat. Finally, eight species are recorded new to the Mongolian fauna, namely *Ameletus cedrensis*, *Siphonurus palaearticus*, *S. zhelochovtsevi*, *Acanthametropus nikolskyi*, *Baetis* (*Labiobaetis*) *atrebatinus*, *Afronurus abracadabrus*, *A. levis*, *Sparbarus corniger*, and *Caenis macronyx* (see Table 1 for details). More than 60 new regional (aimag) records concerning further 47 species are apparent from Table 1 (marked with asterisk) as well.

Naturally, the checklist of Mongolian mayflies cannot be considered definitive from several reasons that might be summarised as follows:

- (1) Synonymy of species found in Mongolia seems to be rather complicated, some species have been described under several names in 3–4 genera and some substantial revisions (e.g. those of Heptageniidae and Caenidae: Brachycercinae) have been published quite recently (Sun and McCafferty 2008; Webb and McCafferty 2008). Consequently, synonymy in our checklist cannot be (also from technical reasons) complete. We restricted it to ‘unambiguous synonymy’, in fact treating only the most important junior subjective synonyms and preliminary determinations (concerning only the material from Mongolia) but omitting the original descriptions and name combination(s). As to preliminary determinations, we succeeded in determining *Ameletus* sp., *Siphonurus* sp., *Metretopus* sp., and *Isonychia* sp. sensu Enktaivan and Soldán (2008) as *A. cedrensis*, *S. palaearticus*, *M. borealis* and *I. ussurica*, respectively, and *Baetis* sp. and *Centroptilum* sp. III sensu Landa and Soldán (1983) as *B. feles* and *Procloeon unguiculatum*. As to preliminary names by Imanishi (1940), we followed the analysis by Bae et al.

Table 1. List of Mongolian mayflies with notes on their distribution including records new to Mongolia or new to Mongolian regions (Aimags), the latter marked with asterisk (*). Within the frame of individual families, genera and species arranged alphabetically.

Family/genus/subgenus/species/ subspecies and its No.	Unambiguous synonymy	Distribution (Aimag)	Literature record (source) and note
Ameletidae			
01. <i>Ameletus cedrensis</i> Sinitshenkova, 1977		*BG	New to Mongolia, EnSo [sub <i>Ameletus</i> sp.]
02. <i>Ameletus inopinatus</i> Eaton, 1887	<i>alpinus</i> Bengtsson, 1913 [<i>Ameletus</i>]; <i>eugenii</i> Sinitshenkova et Varychanova, 1989 [<i>Ameletus</i>]	HO, SE	Dashdorj et al. (1977), BaVa, Kozhova et al. (1978), Erbaeva (1977, 1986), Zaitka (2000), EnSo
03. <i>Ameletus montanus</i> Imanishi, 1930	<i>procerus</i> Bajkova, 1976 [<i>Ameletus</i>]	*BG, HO, SE	BaVa
Siphonuridae			
04. <i>Siphonurus chankae</i> Tshernova, 1952		*BG, HO, SE	Kozhova (1978), BaVa, EnSo [sub <i>Siphonurus</i> cf. <i>chankae</i>] EnSo
05. <i>Siphonurus inmanus</i> Kluge, 1985	<i>Siphonurus chankae</i> sensu Bajkova (1979), nec Tshernova (1952)	HO	
06. <i>Siphonurus lacustris</i> Eaton, 1870	<i>zetterstedti</i> Bengtsson, 1909 [<i>Siphurus</i>]; <i>pyrenaicus</i> Navas 1930 [<i>Siphonurus</i>]; <i>nuessleri</i> Jacob, 1972 [<i>Siphonurus</i>] <i>brodskiyi</i> Bajkova, 1979 [<i>Siphonurus</i>]; <i>Siphonurus binotatus</i> sensu Bajkova (1979) nec Eaton (1872); ? <i>Siphonurus</i> sp. sensu Bajkova (1979)	CV, DO, HO, *SE, UV	BaVa, Kozhova (1978), Br (1982), LaSo, Erbaeva (1986), EnSo
07. <i>Siphonurus palaeartcticus</i> (Tshernova, 1930)		*HO	New to Mongolia, EnSo [sub <i>Siphonurus</i> sp.]
08. <i>Siphonurus zhelechovtsevi</i> Tshernova, 1952		*HO	New to Mongolia
09. <i>Siphonurus (Siphurella)</i> <i>alternatus</i> (Say, 1824)	<i>linnaeanus</i> Eaton, 1871 [<i>Siphurus</i>]; <i>oblita</i> Bengtsson, 1909 [<i>Siphurella</i>] <i>norvegica</i> Esben-Petersen, 1909 [<i>Sparred</i>]; <i>elegans</i> Bengtsson, 1909 [<i>Potameis</i>]; <i>fennica</i> Aro, 1910 [<i>Palmenia</i>]	AR	LaSo, Zaitka (2000)
10. <i>Parameletus chelififer</i> Bengtsson, 1908		*BG, CE, SE	BaVa, Kozhova et al. (1978), Erbaeva (1986), Br (1982)

(continued)

Table 1. (Continued).

Family/genus/subgenus/species/ subspecies and its No.	Unambiguous synonymy	Distribution (Aimag)	Literature record (source) and note
Acanthametropodidae			
11. <i>Acanthametropus nikolskyi</i> Tshernova, 1948	<i>polita</i> Bajkova, 1970 [<i>Isonychia</i>]	*BG, *CE *HO, *SE	New to Mongolia [Kluge, pers. comm.]
Metretopodidae			
12. <i>Metretopus alter</i> Bengtsson, 1928		*BG, HO	EnSo
13. <i>Metretopus borealis</i> (Eaton, 1871)		SE	Kozhova et al. (1978), Erbaeva (1986), EnSo [sub. <i>Metretopus</i> sp.]
14. <i>Metretopus tertius</i> Tiumova, 1999		HO	EnSo
Baetidae			
15. <i>Baetis (Acentrella) fenestratus</i> (Kazlauskas, 1963)	<i>Baetiella</i> 'nX' sensu Imanishi (1940)	*BG, HO, SE	BaVa, Zaika (2000), EnSo
16. <i>Baetis (Acentrella) sibiricus</i> (Kazlauskas, 1963)	<i>Baetiella</i> 'nX' sensu Imanishi (1940); <i>Pseudocloeon fenestratum</i> sensu Bajkova (1968), nec Kazlauskas (1963)	HO, *SE	Zaika (2000), EnSo
17. <i>Baetis (Baetiella) tuberculatus</i> (Kazlauskas, 1963)	<i>japonica</i> 'na' sensu Imanishi, 1940 [<i>Baetiella</i>]; <i>nosegawaensis</i> Gose, 1965 [<i>Pseudocloeon</i> (<i>Baetiella</i>)]	HO, *SE	EnSo
18. <i>Baetis feles</i> Kluge, 1980		*AR, *BG, HO	Zaika (2000), EnSo, LaSo [sub <i>Baetis</i> sp.]
19. <i>Baetis fuscatus</i> (Linnaeus, 1761)	<i>Baetis bioculatus</i> sensu auct., nec <i>Ephemera</i> <i>bioculata</i> Linnaeus, 1758; <i>venustulus</i> Eaton, 1885 [<i>Baetis</i>]; <i>andalusicus</i> Navás, 1911 [<i>Baetis</i>]; <i>japonicus</i> Matsumura, 1931 [<i>Baetis</i>]; <i>Baetis</i> 'nla' sensu Imanishi (1940)	*BG, BU, CV, GA, HO, SE	Dashdorj et al. (1977), BaVa, Kozhova (1978), LaSo, Erbaeva (1986), Zaika (2000), EnSo
20. <i>Baetis ussuricus</i> Kluge, 1983	<i>tenax</i> Eaton, 1870 [<i>Baetis</i>];	HO	Zaika (2000), EnSo
21. <i>Baetis vernus</i> Curtis, 1834	<i>finitimus</i> Eaton, 1871 [<i>Baetis</i>]	CV, HO	Zaika (2000), LaSo, EnSo
22. <i>Baetis mongolicus</i> Tshernova, 1952		DO, SE	Tshernova (1952), BaVa

(continued)

Table 1. (Continued).

Family/genus/subgenus/species/ subspecies and its No.	Unambiguous synonymy	Distribution (Aimag)	Literature record (source) and note
23. <i>Baetis (Labiobaetis) atrebatinus</i> Eaton, 1870	<i>atrebatinus orientalis</i> Kluge, 1983 [<i>Baetis</i>]; <i>morus</i> Kang et Yang, 1994 [<i>Baetis</i> (<i>Muellerbaetis</i>)]	*BG, *HO	New to Mongolia
24. <i>Baetis (Rhodobaetis) bicaudatus</i> Dodds, 1923	<i>Baetis thermicus</i> sensu Imanishi (1940), nec Uéno (1928)	*BG, HO, *SE	Zaika (2000), EnSo
25. <i>Baetis (Rhodobaetis)</i> <i>pseudothermicus</i> Kluge, 1983	<i>bocagii</i> Eaton, 1885 [<i>Baetis</i>]; <i>wallengreni</i> Bengtsson, 1912 [<i>Baetis</i>]; <i>pustillus</i> Bengtsson, 1912 [<i>Baetis</i>]; <i>iberi</i> Navas, 1913 [<i>Baetis</i>]	HO	Zaika (2000), EnSo
26. <i>Baetis (Rhodobaetis) rhodani</i> (Pictet, 1843)		BG, HO, SE	Kozhova et al. (1978), BaVa, Erbaeva (1977, 1986), Zaika (2000)
27. <i>Baetopus asiaticus</i> Soldán, 1978		CB, HO	Soldán (1978), LaSo, EnSo
28. <i>Baetopus montanus</i> Soldán, 1978		BU, HO	Soldán (1978), LaSo, EnSo
29. <i>Centroptilum kazlauskasi</i> Kluge, 1963		*BG, HO, *SE	EnSo
30. <i>Centroptilum luteolum</i> (Müller, 1776)	<i>diaphana</i> Müller, 1776 [<i>Ephemerid</i>]; <i>bioculatum</i> Hagen, 1863 [<i>Cloeon</i>]; <i>semirufum</i> McDunnough, 1926 [<i>Centroptilum</i>]	HO	Zaika (2000), EnSo
31. <i>Cloeon (Cloeon) dipterum</i> (Linnaeus, 1761)	<i>sinensis</i> (Walker, 1853) [<i>Caenis</i>]; <i>zimini</i> Tshermova, 1931 [<i>Cloeon</i>]; <i>robustum</i> Bogoescu, 1933 [<i>Cloeon</i>]; <i>szegedi</i> Jacob, 1969 [<i>Cloeon</i>]	*CE, HO, SE	Dashdorj et al. (1977), BaVa, Erbaeva (1977, 1986), EnSo, Zaika (2000)
32. <i>Cloeon (Interclaeon) spiniventre</i> Kluge et Novikova 1992		CV	LaSo [sub <i>Cloeon simile</i>], Kluge and Novikova (1992)
33. <i>Proclaeon bifidum</i> Bengtsson, 1912	<i>Cloeon rufulum</i> var. 2 sensu Eaton (1885); <i>pseudorufulum</i> Kimmins, 1957 [<i>Proclaeon</i>]; <i>lychnidense</i> Ikonomov, 1962 [<i>Proclaeon</i>]	HO, *SE	EnSo

(continued)

Table 1. (Continued).

Family/genus/subgenus/species/ subspecies and its No.	Unambiguous synonymy	Distribution (Aimag)	Literature record (source) and note
34. <i>Procloeon (Pseudocentropitulum) penulatum</i> (Eaton, 1870)	<i>infrequens</i> McDunnough, 1924 [<i>Centropitulum</i>]	* BG, HO, *SE	EnSo
35. <i>Procloeon (Pseudocentropitulum) unguiculatum</i> (Tshernova, 1941)	<i>motasi</i> Bogoescu, 1947 [<i>Pseudocentropitulum</i>]; <i>limnale</i> Braasch et Soldán, 1983 [<i>Centropitulum</i>]	BC	LaSo [sub <i>Centropitulum</i> sp. III], Kluge and Novikova (1992)
Oligoneuriidae			
36. <i>Oligoneuriella pallida</i> (Hagen, 1855)	<i>yugoslavica</i> Ikonomov, 1958 [<i>Oligoneuriella</i>]; <i>poecile</i> Ikonomov, 1960 [<i>Oligoneuriella</i>]; <i>mikulskii</i> Sowa, 1961 [<i>Oligoneuriella</i>]; <i>mongolica</i> Soldán et Landa, 1977 [<i>Oligoneuriella</i>]	BG, CB, CN, HO, *SE, SU	Soldán and Landa (1977), LaSo, EnSo
Isonychiidae			
37. <i>Isonychia ignota</i> (Walker, 1853)	<i>tolosana</i> Joly, 1870 [<i>Palingenia</i>]; <i>roeselii</i> Joly, 1871 [<i>Palingenia</i>]; <i>ferruginea</i> Albaráa, 1878 [<i>Isonychia</i>]	SE	Kozhova et al. (1978), BaVa, Erbaeva (1977, 1986)
38. <i>Isonychia ussurica</i> Bajkova, 1970		* BG, *HO, *SE	EnSo [sub <i>Isonychia</i> sp.], Br (1982) [sub <i>I. japonica</i>]
Heptageniidae			
39. <i>Afghanurus klugei</i> (Braasch, 1980)		CE	Br (1979a) [sub <i>E. stubbei</i>], Br (1980b)
40. <i>Afghanurus simplicioides</i> (McDunnough, 1924)	<i>werechagini</i> Tshernova, 1952 [<i>Heptagenia</i>]; <i>imanica</i> Bajkova, 1972 [<i>Rhithrogena</i>]	HO, UV, SE	BaVa, EnSo,
41. <i>Afghanurus vicinus</i> Demoulin, 1964		HO	EnSo
42. <i>Afghanurus abraacadabrus</i> (Kluge, 1980)		*BG, *SE	New to Mongolia

(continued)

Table 1. (Continued).

Family/genus/subgenus/species/ subspecies and its No.	Unambiguous synonymy	Distribution (Aimag)	Literature record (source) and note
43. <i>Afromurus levis</i> (Navás, 1912)	<i>zachvatkini</i> Tshernova, 1952 [<i>Cinygmula</i>]; <i>levis</i> Tshernova, 1981 [<i>Epeorus (Betovius)</i>]	*CE, *SE, CE, HO	New to Mongolia Br (1986), EnSo
44. <i>Ecdyogymnurus aspersus</i> Kluge, 1980		*BG, HO	EnSo
45. <i>Ecdyogymnurus inversus</i> Kluge, 1980		BC, *BG, BG, CE, CV, HO, SE	BaVa, Erbaeva (1986), Br (1979a, 1980b, 1986), LaSo, Tshernova et al. (1986), Zaika (2000), EnSo
46. <i>Nixe joernensis</i> (Bengtsson, 1909)	<i>mongolica</i> Bajkova et Varychanova, (1978) [<i>Heptagenia</i>]; <i>Ecdyonurus flavomaculatus</i> Aro, 1928 [<i>Ecdyonurus</i>]; <i>dentata</i> Braasch, 1979 [<i>Heptagenia</i>]; <i>stubbet</i> Braasch, 1979 [<i>Ecdyonurus</i>], p.p. (larvae) ? <i>pulla</i> (Clemens, 1913) [<i>Heptagenia</i>]	BG, CN, CV, HO, SE	BaVa, Br (1979a), BaVa, LaSo, EnSo
47. <i>Heptagenia dalecarlica</i> Bengtsson, 1912	<i>citrina</i> Hummel, 1825 [<i>Ephemera</i>]; <i>bipunctata</i> Esben-Petersen, 1916 [<i>Heptagenia</i>]; <i>Heptagenia</i> 'na' sensu Imanishi (1940); <i>arsenjevi</i> Tshernova, 1952 [<i>Heptagenia</i>]; <i>cyanops</i> Pictet, 1843 [<i>Baetis</i>]; ? <i>soldatovi</i> Tshernova, 1952 [<i>Heptagenia</i>]	*BG, BU, *CE, CN, CV, HO, SE	Dashdorj et al. (1977), Kozhova et al. (1978), BaVa, Br (1979a, 1986), LaSo, Erbaeva (1986), Zaika (2000), EnSo
48. <i>Heptagenia flava</i> Rostock, 1877		*BG, BU, CE, HO, *SE, UV	Br (1979b, 1986), LaSo [sub <i>Heptagenia</i> sp.], Zaika (2000), EnSo
49. <i>Heptagenia sulphurea</i> (Müller, 1776)	<i>altaica</i> Tshernova, 1949 [<i>Cinygmula</i>]; <i>guentheri</i> Braasch, 1979 [<i>Cinygmula</i>]; <i>kaszabi</i> Landa et Soldan, 1983 [<i>Cinygmula</i>]	CE, CN, CV, HO, *SE, UV AR, CE, CN, *BG GA, HO CE, TO HO	BaVa, Br (1979a, 1986), Tshernova et al. (1986), Zaika (2000), EnSo Kozhova et al. (1978), Br (1986), LaSo, EnSo Br (1980a, 1986) Zaika (2000), EnSo
50. <i>Cinygmula cava</i> (Ulmer, 1927)			
51. <i>Cinygmula kurenzovi</i> Bajkova, 1962			
52. <i>Cinygmula minuta</i> Braasch, 1980	<i>Cinygmula altaica</i> sensu Bajkova (1974) nec Tshernova (1949)		
53. <i>Cinygmula putoranica</i> Kluge, 1980			

(continued)

Table 1. (Continued).

Family/genus/subgenus/species/ subspecies and its No.	Unambiguous synonymy	Distribution (Aimag)	Literature record (source) and note
54. <i>Epeorus (Belovius) pellucidus</i> (Brodsky, 1930)	<i>Epeorus latifolium</i> sensu Tshernova (1949), nec Uéno (1928); <i>smirnovi</i> Tshernova, 1978 [<i>Cinygmula</i>]; <i>tshernovae</i> Braasch, 1979 [<i>Epeorus</i>], nec <i>tshernovae</i> Sinitshenkova, 1982 [<i>Iron</i>] <i>sinitshenkovae</i> Tshernova, 1981 [<i>Epeorus (Belovius)</i>] <i>rauttiani</i> Sinitshenkova, 1982 [<i>Epeorus</i>]	AR, BC, *BG, CE, HO	Br (1979b, 1986), EnSo
55. <i>Epeorus (Belovius) ninae</i> Kluge, 1995	<i>sinitshenkovae</i> Tshernova, 1981 [<i>Epeorus (Belovius)</i>]	HO, *SE	EnSo
56. <i>Epeorus (Proepeorus) anatolii</i> Sinitshenkova, 1981	<i>rauttiani</i> Sinitshenkova, 1982 [<i>Epeorus</i>]	CE	Br (1986)
57. <i>Epeorus (Iron) alexandri</i> Kluge et Tünova, 1989	<i>Iron levitidovae</i> Sinitshenkova, 1982 [partim, larva]; <i>Iron maculatus</i> sensu Bajkova (1974), nec Tshernova (1949)	SE	Kozhova et al. (1978), BaVa, Erbaeva (1977, 1986)
58. <i>Epeorus (Iron) maculatus</i> Tshernova, 1949	<i>Baetis 'nla'</i> sensu Imanishi (1940), <i>Epeorus aesculus</i> p.p. sensu Imanishi (1940); <i>latericius</i> Sinitshenkova, 1982 [<i>Iron</i>]; <i>tshernovae</i> Sinitshenkova, 1982 [<i>Iron</i>], nec <i>tshernovae</i> Braasch, 1979 [<i>Epeorus</i>]	CE, CV	Br (1979a, 1986), LaSo
59. <i>Rhithrogena piechockii</i> Braasch, 1977		CV	Br (1977)
60. <i>Rhithrogena (Rhithrogena)</i> <i>bajkovae</i> Sowa, 1973	<i>quadrinotata</i> Sinitshenkova, 1982 [<i>Rhithrogena</i>]	BG, BC, CE, CV, SE, UV	BaVa; Br (1979a), LaSo, Zaika (2000), EnSo
61. <i>Rhithrogena (Rhithrogena)</i> <i>lepnevae</i> Brodsky, 1930	<i>unicolor</i> Tshernova, 1952 [<i>Rhithrogena</i>]; <i>binotata</i> Sinitshenkova, 1982 [<i>Rhithrogena</i>]	BU, CE, CN, CV, HO, SE UV	BaVa, Br (1979a, 1986), Erbaeva (1986), LaSo, Zaika (2000), EnSo
62. <i>Rhithrogena (Sibirigena) sibirica</i> Brodsky, 1930		*BG, BU, CV, HO, *SE	Dashdorj et al. (1977), BaVa, Br (1979a, 1986), LaSo, EnSo [sub <i>Rhithrogena</i> sp.]

(continued)

Table 1. (Continued).

Family/genus/subgenus/species/ subspecies and its No.	Unambiguous synonymy	Distribution (Aimag)	Literature record (source) and note
Leptophlebiidae			
63. <i>Choroterpes (Euthraulus) altioculus</i> Kluge, 1984	<i>Choroterpes trifurcata</i> auct. antea 1985	CV, *BG	Br (1982) [sub <i>Ch. trifurcata</i>], Kluge (1986), Zaika (2000)
64. <i>Paraleptophlebia chocolata</i> Imanishi, 1937	<i>cothurnata</i> Tshernova, 1952 [<i>Paraleptophlebia</i>]	CV, *HO, *SE	Br (1982)
65. <i>Paraleptophlebia strandii</i> Eaton, 1901	<i>lunata</i> Tshernova, 1928 [<i>Leptophlebia</i>]	HO	Zaika (2000), EnSo
Potamanthidae			
66. <i>Potamanthus luteus</i> Linné 1767	<i>lutea</i> Linné, 1767; [<i>Ephemera</i>]; <i>reaumuri</i> Joly et Joly, 1876 [<i>Eucharidis</i>]	BG, *HO, SE	Dashdorj et al. (1977), BaVa, Kozhova (1978), LaSo, Erbaeva (1977, 1986)
Ephemeridae			
67. <i>Ephemera orientalis</i> McLachlan, 1875	<i>amurensis</i> Navás, 1912 [<i>Ephemera</i>]; <i>modesta</i> Brodsky, 1930 [<i>Ephemera</i>]	CV, HO, *SE *BG, HO, *SE	BaVa, Br (1982), LaSo, Kluge (1986), Tshernova et al. (1986), EnSo
68. <i>Ephemera sachalinensis</i> Matsumura, 1934	<i>kuwamayai</i> Navás, 1920 [<i>Ephemera</i>]; <i>iwatensis</i> Matsumura, 1931 [<i>Ephemera</i>]; <i>jezonica</i> Matsumura, 1931 [<i>Ephemera</i>]	*BG, HO, SE	Dashdorj et al. (1977), Kozhova (1978), LaSo, Erbaeva (1977), Tshernova et al. (1986), EnSo
69. <i>Ephemera (Simephemera) strigata</i> Eaton, 1892		*BG, HO, SE	
70. <i>Ephemera transbaikalica</i> Tshernova, 1973			
Polymitarcyidae			
71. <i>Ephoron nigridorsum</i> (Tshernova, 1934)	<i>ladogensis</i> Tienstuu, 1935 [<i>Polymitarcys</i>]	BG, CB, CE, CV, SE	Kozhova et al. (1978), BaVa, LaSo, Erbaeva (1986), Tshernova et al. (1986), Zaika (2000)
72. <i>Ephoron virgo</i> (Olivier, 1791)		SE	BaVa

(continued)

Table 1. (Continued).

Family/genus/subgenus/species/ subspecies and its No.	Unambiguous synonymy	Distribution (Aimag)	Literature record (source) and note
Ephemerellidae			
73. <i>Drunella</i> (<i>Myllylonella</i>) <i>lepnevae</i> (Tshernova, 1949)	<i>longipenes</i> Tshernova 1952 [<i>Ephemerella</i>]; <i>fusongensis</i> Su et Gui, 1995 [<i>Ephemerella</i>]; <i>Ephemerella trispina</i> 'nM' sensu Imanishi (1940)	CV, SE	BaVa, Br (1982), Tshernova et al. (1986)
74. <i>Drunella</i> (<i>Tribrochella</i>) <i>cryptomeria</i> (Imanishi, 1937)	<i>bicornis</i> Gose, 1980 [<i>Ephemerella</i>]; <i>giliesi</i> Allen et Edmunds, 1963 [<i>Ephemerella</i> (<i>Drunella</i>)]; <i>Ephemerella trispina</i> 'nG' sensu Imanishi (1940)	*CE, HO, *SE	EnSo
75. <i>Drunella</i> (<i>Tribrochella</i>) <i>latipes</i> (Tshernova, 1952)	<i>traverae</i> Allen et Edmunds, 1963 [<i>Ephemerella</i> (<i>Drunella</i>)]; <i>kabulensis</i> Allen, 1971 [<i>Ephemerella</i> (<i>Drunella</i>)]	SE	Dashdorj et al. (1977), BaVa, Erbaeva (1977, 1986) LaSo, EnSo
76. <i>Drunella</i> (<i>Tribrochella</i>) <i>submontana</i> (Brodsky, 1930)	<i>tenax</i> Tshernova, 1952 [<i>Ephemerella</i>]; <i>Ephemerella trispina</i> 'naa' sensu Imanishi (1940)	CV, HO	
77. <i>Drunella</i> (<i>Tribrochella</i>) <i>triacantha</i> (Tshernova, 1949)		CV, HO, SE	Dashdorj et al. (1977), BaVa, Br (1982), Erbaeva (1986), Tshernova et al. (1986), Zaika (2000), EnSo, BaVa, Erbaeva (1977, 1986)
78. <i>Drunella</i> (<i>Tribrochella</i>) <i>trispina</i> (Uéno, 1928)		SE	
79. <i>Ephemerella aurivillii</i> Bengtsson, 1908	<i>aronii</i> Eaton, 1908 [<i>Chitonophora</i>]; <i>norda</i> McDunnough, 1924 [<i>Ephemerella</i>]; <i>concinna</i> Traver, 1934 [<i>Ephemerella</i>]; <i>Ephemerella</i> 'nN' sensu Imanishi (1940); <i>taeniata</i> Tshernova, 1952 [<i>Ephemerella</i>]; <i>maxima</i> Allen, 1971 [<i>Ephemerella</i>]; <i>ezoensis</i> Gose, 1980 [<i>Cincticostella</i>];	*BG, *CE, HO, SE	Dashdorj et al. (1977), BaVa, Erbaeva (1977, 1986), EnSo

(continued)

Table 1. (Continued).

Family/genus/subgenus/species/ subspecies and its No.	Unambiguous synonymy	Distribution (Aimag)	Literature record (source) and note
80. <i>Ephemerella mucronata</i> (Bengtsson, 1909)	<i>krieghoffi</i> Ulmer, 1920 [<i>Chitonophora</i>]; <i>unicolorata</i> Ikonomov, 1961 [<i>Chitonophora</i>]; <i>krieghoffi intermedia</i> Keffermüller, 1979 [<i>Ephemerella</i>]; <i>moffatae</i> Allen, 1977 [<i>Ephemerella</i>]	CV, *BG HO, SE, UV	Kozhova et al. (1978), BaVa, Br (1982), LaSo, Zaika (2000), EnSo
81. <i>Ephemerella ignita</i> (Poda, 1761)	<i>lactata</i> Bengtsson, 1909 [<i>Ephemerella</i>]; <i>torrentium</i> Bengtsson, 1917 [<i>Ephemerella</i>]; <i>sibirica</i> Tshernova, 1952 [<i>Ephemerella</i>]; <i>karasuensis</i> Kustareva, 1976 [<i>Drunella</i>]; <i>antuenensis</i> Su & You, 1989 [<i>Ephemerella</i>]; <i>thymalli</i> Tshernova, 1952 [<i>Ephemerella</i>]; <i>verrucosa</i> Kluge, 1980 [<i>Ephemerella</i>]	*BG, CE, CV, HO, *SE, ZA	Kozhova et al. (1978), BaVa, LaSo, Br (1982), EnSo
82. <i>Ephemerella nuda</i> Tshernova, 1949	<i>Ephemerella trispina</i> 'naz' sensu Imanishi (1940)	HO, SE	BaVa, Kluge (1986), Zaika (2000), EnSo
83. <i>Ephemerella setigera</i> Bajkova, 1965	<i>markevithsi</i> Belov, 1979 [<i>Uracanthella</i>]	SE	BaVa
84. <i>Ephemerella zapetinae</i> Bajkova, 1967	<i>rufa</i> Imanishi, 1939 [<i>Ephemerella</i>]	SE	BaVa
85. <i>Uracanthella lenoki</i> (Tshernova, 1952)		*CE, HO, SE	BaVa, EnSo
86. <i>Uracanthella punctisetae</i> (Matsumura, 1931)		CV, ZA	Br (1982)
Caenidae			
87. <i>Brachycercus harrisellus</i> Curtis, 1834	<i>pennata</i> Stephens, 1835 [<i>Caenis</i>]; <i>pallidus</i> Tshernova, 1928 [<i>Brachycercus</i>]; <i>magnus</i> Tshernova, 1952 [<i>Brachycercus</i>]; <i>arcticus</i> Soldán (1986) [<i>Brachycercus</i>]; <i>edmundsi</i> Soldán (1986) [<i>Brachycercus</i>]	HO, *SE	EnSo
88. <i>Cercobrachys minutus</i> (Tshernova, 1952)		SE	Dashdorj et al. (1977), Kozhova (1978), BaVa, Erbaeva (1977, 1986)

(continued)

Table 1. (Continued).

Family/genus/subgenus/species/ subspecies and its No.	Unambiguous synonymy	Distribution (Aimag)	Literature record (source) and note
89. <i>Sparbarus corniger</i> (Kluge, 1991)	<i>Brachycercus magnus</i> sensu Soldán (1986), nec Tshernova (1952)	*BG, *SE	New to Mongolia
90. <i>Sparbarus tubulatus</i> (Tshernova, 1952)		SE	BaVa
91. <i>Caenis horaria</i> (Linnaeus, 1758)	<i>lactella</i> Eaton, 1884 [<i>Caenis</i>]	HO, SE, UV CV, HO	BaVa, LaSo, Zaika (2000), EnSo, LaSo, EnSo
92. <i>Caenis jungi</i> Braasch, 1980		*HO	New to Mongolia, EnSo, [sub <i>Caenis</i> sp.]
93. <i>Caenis macronyx</i> Kluge, 1986		SE	Kozhova et al. (1978), BaVa, Erbaeva (1977, 1986)
94. <i>Caenis maculata</i> Tshernova, 1952		SE	Kozhova et al. (1978), BaVa, Erbaeva (1977, 1986)
95. <i>Caenis militaria</i> Tshernova, 1952	<i>Caenis robusta</i> sensu Tshernova et al. (1986), p.p.	SE	Kozhova et al. (1978), BaVa, Erbaeva (1977, 1986)
96. <i>Caenis robusta</i> Eaton, 1884	<i>incus</i> Bengtsson, 1912 [<i>Caenis</i>]; <i>ulmeri</i> Brodsky, 1930 [<i>Caenis</i>]	CB, CE, CV, HO	Br (1982), LaSo, EnSo

Abbreviations of the administrative units (Aimags) of Mongolia: AR – Archangai; BC – Bajan-Chongor; BG – Bulgan; BU – Bajan-Ulgij; CB – Choibalsan; CE – Central; CN – Chentei; CV – Chovd; DO – Dornod; GA – Gobi Altai; HO – Hovsgol; SE – Selenge; SU – Suchebaator; TO – Töv; UV – Uvs; ZA – Zavchan. Abbreviations of the most frequently cited literature sources: BaVa – Bajkova and Varychanova (1978); Br – Braasch; EnSo – Enktaivan and Soldán (2008); LaSo – Landa and Soldán (1983).

(2000) who managed to determine all provisional names except for *Isonychia* 'na' sensu Imanishi (1940) reported by Bajkova and Varychanova (1978) from the Selenge river basin. *Oligoneuriella mongolica* described by Soldán and Landa (1977) from Mongolia has been synonymised by Kluge (2004) with European *O. pallida*. However, the structure of inner penis lobes and egg chorion are apparently different and a comparison of type material has never been made. *Caenis miliaria* originally described by Tshernova (1952) from the Amur basin was found conspecific with *C. robusta* (cf. Tshernova et al. 1986) but seems to be a good species (cf. Kluge 1997). However, critical revision of type material, now in collection of the Zoological Institute in St. Petersburg (Kluge 1995), has not yet been made.

As to recent changes at generic level we have accepted the new status of some genera of Heptageniidae and newly treated three Mongolian species [(i.e. *Ecdyogymnurus aspersus* Kluge, 1980, comb. nov., *E. inversus* Kluge, 1980, comb. nov.; *E. kibunensis* (Imanishi, 1936), comb. nov.] and changes in Caenidae (*Brachycercus* auct. 2008 antea, p.p. = *Sparbarus* Sun et McCafferty, 2008).

- (2) Some species, which have been recorded from Mongolia, are not incorporated into our checklist. We decided not to do so since no precise localities of occurrence are known or have not yet been published, as far as we know. This concerns the species with general notes like 'distributed in Mongolia' or so, however their real occurrence in Mongolia seems to be very likely. In this way, some species are presented in keys by Tshernova et al. (1986) and Kluge (1997) dealing with mayfly fauna of the Russian Far East and Russia, respectively. Zaika (2000) published a key of mayflies dealing with fauna of 'Tuva (autonomous area in Russia near the northwestern border of Mongolia) and West Mongolia' but he apparently collected in Tuva only. If data of some species supposed to be distributed in Mongolia could be verified by factual findings (mainly in Bajkova and Varychanova 1978; Landa and Soldán 1983; Enktaivan and Soldán 2008), a respective citation was incorporated into Table 1. Further species in question (i.e. those reported from Mongolia without any specification) concern the following species: *Baetis* (*Acentrella*) *gnom* Kluge, *Baetis* (*Acentrella*) *lapponicus* Bengtsson, *Baetopus* (*Baetopus*) *wartensis* Keffermüller, *Cinygmula grandifolia* Tshernova, and *Ephemerella kozhovi* Bajkova. The occurrence of further species recorded from Tuva also seems to be likely in Mongolia: *Ameletus alexandrae* Brodsky, *Siphonurus aestivalis* Eaton, *Baetis oreophilus* Kluge, *B. transiliensis* Brodsky, *Cynigma lyriforme* McDunnough, *Cinygmula hirasana* Imanishi, *Epeorus aesculus* (Imanishi), and *Ephemerella dentata* (Bajkova).
- (3) Some species (or their distribution in Mongolia) in our checklist seem to be at least controversial or their occurrence in Mongolia doubtful. First of all, this concerns the well-known and apparently polytypic *Baetis rhodani*, the neotype of which has been suggested quite recently (Gattolliat and Sartori 2008), including DNA sequence. Another species belonging to this category is *Choroterpes* (*Euthralus*) *trifurcata* Uéno, which is recorded from Mongolia only by Braasch (1982). It currently has been confused with *Ch. altioculus*, which is most probably not distributed in this region (cf. Kluge 1985), and respective material needs to be re-examined. The same concerns the occurrence of *Isonychia japonica* Ulmer, a species restricted to Japan.

The material recorded by Braasch (1982) apparently belongs to *I. ussurica* (cf. Tiunova et al. 2004). *Baetis mongolicus* described from Mongolia's eastern-most part (the Amur basin) by Tshernova (1952) and later recorded by Bajkova and Varychanova (1978) seems to represent a doubtful taxon. The original description does not define critical distinguishing characters and type material formerly in Tshernova's collection in Moscow is most probably lost (Kluge 1995). Taking into account distribution data on some species reported from Mongolia, their distribution in this area seems to be unlikely and respective material urgently needs re-examination. This concerns some species recorded by Bajkova and Varychanova (1978), Kozhova et al. (1978), Braasch (1979a) and Erbaeva et al. (1986), namely *Afronurus yoshidae* (Takahashi), *Ecdyogymnurus kibunensis* (Imanishi) [comb. nov.], *Epeorus (Belovius) latifolium* Uéno, 1928, and *Epeorus (Iron) curvatulus* Matsumura, 1931, the distribution of which is restricted to the Japanese islands. At this time they cannot be incorporated in the list until the original material will be carefully revised.

- (4) The entire territory of Mongolia is extremely large (1,566,500 km² with 18 administrative units, i.e. aimags) but very sparsely inhabited (2.5 million inhabitants; population density about 1.7 inhabitant/km²). Most of the localities investigated are situated in relatively small and more densely populated areas in the Selenge (Yenisey) River basin (mainly the Bulgan, Selenge and Hovsgol Aimag) at the biotopes of forest tundra and of continental meadow forest steppe. Other main habitat formations (Gobi, Dzhungaria, Khangai and Altai Mts. and intramontaneous area), however poor in aquatic habitats, remain nearly untouched. Contrary to several hundreds of localities investigated in the Selenge basin, only about 25 localities have been sampled (predominantly by light traps) in semi-deserts of clean-cut continental habitats, eastern part of Altai Mts. and in the Chalchyn-gol River basin in the eastern part of Gobi desert by Dr. Kaszab's expeditions (see Landa and Soldán 1983 for details). In other words, a species-rich fauna occurs just in the Selenge and Orchon basins – about 65 and 40 species in the Selenge and Hovsgol Aimags, and Bulgan Aimag, respectively, while only 5–10 species inhabit individual aimags in other areas (e.g. Uvs, Gobi Altai, Zavchan and others). On the other hand, data on mayflies are completely missing only from two aimags (out of 18 aimags of Mongolia).

Consequently, more intensive research is urgently needed especially in these regions. Taking into account the species richness of some adjacent areas in the Russia Far East or North-western China (about 300 species) on the one hand as well as a relative uniformity of Mongolian aquatic habitats in general (deserts, semi-desert and grass steppes at relatively high elevations of 800–1500 m a.s.l. on average) on the other, about 150–200 mayfly species might be present in the fauna of the country.

As far as biogeographic analysis is concerned, the mayfly fauna of Mongolia consists of following components (here classified according to the area size):

- (1) Large area species (about 1% of Mongolian mayfly fauna) are represented by the only species, *Cloeon dipterum*, distributed in Europe,

- North Africa, Eurasia including Near East, the Nearctic and in northern parts of the Oriental Region (at least transitory areas in India and China).
- (2) Holarctic species (10–13 species, about 12% of Mongolian mayfly fauna) consisting of three distinct groups from the chorological point of view: (a) holarctic species with large areas: *Procloeon pennulatum*, *Centroptilum luteolum*, *Ephemerella mucronata* and (probably) *Brachycercus harrisellus*, provided that Nearctic populations are conspecific with Palaearctic ones (cf. Sun and McCafferty 2008); (b) circumpolar (tundral) species inhabiting mainly Palaearctic and Nearctic subarctic areas with an evident southern area extensions just to Mongolia in the East Palaearctic subarea (*Ameletus inopinatus*, *Siphonurus alternatus*, *Parameletus chelififer*, *Metretopus borealis*, *Ephemerella aurivillii*, *Heptagenia dalearlica* might belong to this group as well, provided that it is conspecific with Nearctic *H. pulla* Clemens); (c) species with East Palaearctic and Nearctic (North Pacific) distribution: *Baetis bicaudatus* (large Palaearctic subarea in Siberia with an area extension to the Ural Mountains), *Afghanurus simplicioides*, and (possibly) *Acanthametropus nikolskyi* (provided that the latter is conspecific with Nearctic *Metreturus peccatonica* Burks, cf. Kluge 2004).
 - (3) Palaearctic faunal components (21–23 species, about 22% of species found in Mongolia) consisting of two distinct groups from the chorological point of view: (a) Palaearctic (Transpalaearctic species) with larger areas: (*Siphonurus lacustris*, *Baetis fuscatus*, *B. vernus*, *B. atrebatinus* (disjunctive area), *Cloeon simile*, *Procloeon bifidum*, *Oligoneuriella pallida*, *Isonychia ingnota*, *Heptagenia flava*, *H. sulphurea*, *Potamanthus luteus* (disjunctive area, East Palaearctic and area in European/North African subareas), *Ephoron virgo*, *Ephemerella ignita*, *E. mucronata*, *Cercobrachys minutus*, *Caenis horaria*, and *C. robusta*. *Brachycercus harrisellus* and *Heptagenia dalearlica* might belong to this group as well [see above, sub (2)a, species with Holarctic distribution]; (b) tundral (oreotundral) species inhabiting mainly Palaearctic and Nearctic subarctic areas with an evident southern area extension to Mongolia in East Palaearctic *Metretopus alter*, *Nixe joernensis*, *Paraleptophlebia strandii*, *Ephoron nigridorsum*, and possibly *Baetis lapponicus*, provided that it really occurs in Mongolia (cf. Zaika 2000).
 - (4) East Palaearctic species, the most numerous species group consisting of 57–60 species (about 60% of species found in Mongolia); *Acanthametropus nikolskyi* might belong to this group as well (see above, sub East Palaearctic and Nearctic (North Pacific) distribution). Distribution of these species are most diversified; there are at least five area types: (a) species with very large distribution in Siberia and Russian Far East showing an apparent disjunction(s) to subarctic Northeast Europe (*Baetis feles*) or to East Europe and/or Central Asia (*Cloeon spiniventre*, *Procloeon unguiculatum*, cf. Kluge and Novikova 1992); (b) species with a distribution centre probably in Central Asia with a probable area disjunction to Mongolia representing easternmost places of occurrence (*Drunella submontana*, *Caenis jungi*); (c) East Palaearctic species with area disjunction to the Oriental region (e.g. China, Taiwan); Mongolia might represent localities with northernmost occurrence (e.g. *Afronurus levis*); (d) East Palaearctic species with larger areas also including Japanese islands (e.g. *Ameletus montanus*, *Baetis tuberculatus*, *Epeorus pellucidus*, *Paraleptophlebia chocolata*, *Drunella cryptomeria*,

Uracanthella punctisetae). In some cases, Mongolia represents westernmost localities of occurrence and (e) Continental East Palaearctic species usually widely distributed in the Far East, Primoriye and Amur basin (most species of this group, cf. Tshernova 1952; Tshernova et al. 1986; Kluge 1997), some of them also in the Altai Mountains, Kamtchatka Peninsula, Sakhalin and the Kuril Islands (*Cinygmula cava*).

- (5) East Palaearctic species found so far only in Mongolia with insufficiently known area (five species, about 5% of Mongolian mayfly fauna): *Baetopus asiaticus*, *B. montanus*, *Cinygmula minuta*, *Afghanurus klugei*, *Rhithrogena piechockii*. The species of *Baetopus*, known from several aimags in the Selenge River basin (Soldán 1978; Enktaivan and Soldán 2008), undoubtedly possess a large area at least in the whole Yenisey basin, and the remaining species are known only from the type localities (*C. minuta*, *R. piechockii*) or two adjacent localities (*A. klugei*, cf. Braasch 1977, 1979b, 1980b). Naturally, some degree of endemism cannot be excluded, but this problem will not be solved until more details of respective areas are known.

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