New synonymy and new data on the distribution of the mayflies from Korea and the Russian Far East (Ephemeroptera)

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Introduction

About one hundred and fifty species of mayflies occur in the Far East of Russia which is close to two thirds of all known Northeast Asian mayflies (Tshernova et al., 1986; Bae, 1997). Tshernova, Bajkova, Sinitshenkova, Kluge, and Tiunova mainly contributed to the knowledge of mayfly fauna of the Far East of Russia. On the other hand, sixty-six species of mayflies have been reported from Korea since 1940 (Bae et al., 1994; Bae, 1997). The North Korean mayfly fauna has been thoroughly investigated recently (Braasch & Soldan, 1988; Bae & Soldan, 1997; Bae & Andrikovics, 1997).

Although geographically adjacent, mayflies from Korea and the Far East of Russia have been scarcely treated together until 1980s because of the communication problems between those countries. For this study, we intensively examined type and non-type material from Korea and the Far East of Russia. We deal herein with new synonymy, taxonomic discussions on some problematic species, and new distributional data.

Material

Mayflies from the Far East of Russia (FE Russia), North Korea (N Korea), and South Korea (S Korea) were examined. For detailed information on type material deposited at Zoological Institute in St.Petersburg (ZIN), see Kluge (1995). For numerous non-type specimens (many of them reared) deposited at St.Petersburg State University (SPbU), see various Kluge's previous papers. For type and non-type material deposited at Seoul Women's University (SWU), see Bae et al. (1994) and Bae's various previous papers.
Taxonomic account

Family BAETIDAE

Baetis (Baetis) fuscatus (Linnaeus, 1761)

_Baetis_ n.la: Imanishi, 1940: 221 (larva; N Korea, Japan, Manchuria); Yoon & Bae, 1988a: 111 (S Korea).

_Baetis fuscatus_ (L.): Müller-Liebenau, 1969: 128 (larva, imago; Europe); Kluge, 1980: 562 (Siberia); Tshernova et al., 1986: 133 (imago; FE Russia); Bae & Soldan, 1997 (N Korea).


Material examined. Numerous larvae, imagines, and imagines reared from larvae (Europe, Siberia, FE Russia, N Korea, S Korea; SPbU, SWU).

Imanishi (1940) described larvae of this species as "_Baetis n.la_" from North Korea, Japan, and Manchuria. Since then, there have been many faunistic studies in Korea listing this species under the arbitrary name "_Baetis n.la_" which refers to any _fuscatus_-type baetid (see Yoon & Bae, 1988a). This is a transpalaearctic species known from Europe to East Asia. The form distributed in Siberia and the Far East differs from that of Europe by orange colour of turban eyes of male imago (Kluge, 1980). It is a very common species in the Far East of Russia and in Korea occurring from upper to down stream areas, sometimes in polluted streams.

Baetis (Nigrobaetis) muticus (Linnaeus, 1758)


_Baetis KuA: Yoon & Bae, 1988a: 111 (S Korea).

_Baetis (Nigrobaetis) muticus_ (L.): Novikova & Kluge, 1987: 10; Novikova & Kluge, 1994: 635 (larva, imago; Europe, East Kazakhstan); Kluge, 1997: 190 (larva); Bae & Soldan, 1997 (N Korea).

_Alainites muticus_ (L.): Waltz et al., 1994: 34 (Europe).

Material examined. Numerous larvae, imagines, and imagines reared from larvae from Europe, the Urals and Caucasus, one larva from Eastern Kazakhstan (SPbU). _Baetis KuA: Yoon & Bae, 1988 (N Korea, S Korea; SWU).

This species has been known from Korea as "_Baetis KuA_" since Yoon & Bae (1988a). Based on examination of a good series of larval material from Europe and Asia, we determine this species as _Baetis (Nigrobaetis) muticus_. Formerly the easternmost point of recorded distribution of _B. (N.) muticus_ was Eastern Kazakhstan (Novikova & Kluge, 1994).

Waltz et al. (1994) suggested a new classification for selected baetid groups, in which the genus _Alainites_ Waltz & McCafferty, 1994 was established with the type species _Ephemera mutica_ Linnaeus, 1758 (wrongly spelled as "_Baetis muticus_ L., 1758"). According to our investigation (Novikova & Kluge, 1994), the type species of _Alainites_ is undoubtedly congeneric with the type species of _Takobia_ Novikova & Kluge, 1987, and both can be placed in the subgenus (or genus) _Nigrobaetis_ Kazlauskas in Novikova & Kluge, 1987 (see Kluge, 1997: 189).

Family HEPTAGENIIDAE

_Ecdyonurus (Afghanurus) bajkovae_ Kluge, 1986

_Paracinygmula zhitlzowae_ Bajkova, 1975: 56 (nom. praecoc.) (larva; FE Russia).


_Nixe subspinosa_ Braasch & Soldan, 1988: 25 (imago; N Korea), syn. n.

_Ecdyonurus subspinosa_ (Braasch & Soldan): Bae et al., 1994: 40 (S Korea).

_Ecdyonurus (Afghanurus) bajkovae_ Kluge, 1997: 200 (larva; FE Russia).

Material examined. Holotype and paratypes (larvae) of _Paracinygmula zhitlzowae_ Bajkova, 1975 = _Ecdyonurus bajkovae_ Kluge, 1986 (FE Russia, ZIN). Larvae, imagines and imagines reared from larvae (FE Russia, N Korea, S Korea; SPbU, SWU).

This species was originally described from larvae from the Far East of Russia (Bajkova, 1975) and Korea (Yoon & Bae, 1984). The adults were reared from larvae from the Far East of Russia and described by Kluge (1983). Soldan, on the other hand, collected the adult of the same species from North Korea in 1986 and described it under the name _Nixe subspinosa_ Braasch & Soldan, 1988. Soldan also collected larvae and reared adults of _N. subspinosa_ from North Korea (see Bae & Soldan, 1997).

This species was placed in the genus _Paracinygmula, Ecdyonurus, or Nixe_. The type species of _Paracinygmula_ Bajkova, 1975 and the type species of _Nixe_ Flowers, 1980 are undoubtedly congeneric with the type species of _Afghanurus_ Demoulin, 1964.
(Kluge, 1988), and all of them can be placed in the genus *Ecdyonurus* Eaton, 1868 s.l.

**Ecdyonurus (Afghanurus) joernensis** Bengtsson, 1909

*Ecdyonurus joernensis* Bengtsson, 1909: 19 (female imago; Europe).

*Heptagenia mongolica* Bajkova & Varychanova, 1978: 111 (larva; Mongolia).

*Heptagenia dentata* Braasch, 1979: 69 (imago; Mongolia).


*Ecdyonurus* (N. J. Bae, 1984: 14 (larva; S Korea).


*Ecdyonurus (Afghanurus) joernensis* Bengtsson: Kluge, 1997: 200 (larva; Scandinavia, Russia, Mongolia).

Material examined. Numerous larvae, imagines and imagines reared from larvae (Europe, the Urals, Siberia, Mongolia, FE Russia, S Korea; SPbU, SWU).

This is a transpalaearctic species occurring from Europe to East Asia. On its systematic position see discussion above, under *Ecdyonurus (Afghanurus) bajkovae*; the usage of the generic name *Heptagenia* for this species was undoubtedly wrong.

**Epeorus curvatulus** Matsumura, 1931

*Epeorus curvatulus* Matsumura, 1931: 1477 (Japan); Imanishi, 1934: 392 (larva, imago; Japan); Imanishi, 1940: 250 (larva; N Korea, S Korea, Manchuria); Braasch & Soldan, 1988: 27 (N Korea); Kluge, 1997: 205 (larva).


*Epeorus rautili* Sinitshenkova, 1982: 52 (larva, imago; Siberia) (synonymized with *E. anatolii* by Tiunova, 1989: 7); Tshernova et al., 1986: 117 (imago; Siberia); Kluge, 1995: 27 (type deposition).

Material examined. Larvae and imagines (S Korea, FE Russia; SWU, SPbU). Holotypus (larva) of *E. anatolii* Sinitshenkova, 1981 (FE Russia; ZIN). Paratypes (larvae, imagines and imagines reared from larvae) of *E. rautili* Sinitshenkova, 1982 (Siberia; ZIN).

In the original description of the subgenus *Belovius* Tshernova, 1981, this taxon was characterized by imaginal features only; a number of unrelated species of which important larval characters were unknown were placed there, *E. curvatulus* among them. Sinitshenkova (1981) gave a diagnosis of the subgenus *Belovius* based on larval characters: each of tergaliae of the pairs II-VII has a wide proximal lobe separated from remainder of tergiala by posterior costa. With this diagnosis, *Belovius* became a natural taxon. According to this diagnosis, *E. curvatulus* must be placed not in *Belovius*, as each tergiala of *E. curvatulus* has the posterior costa on its posterior margin. Based on this character, Sinitshenkova described *E. anatolii* as belonging not to *Belovius*, but to the subgenus *Epeorus* s. str.

**Epeorus (Iron) aesculus** Imanishi, 1934

*Epeorus aesculus* Imanishi, 1934: 384 (imago, larva partim; Japan); Imanishi, 1940: 250 (larva; N Korea).

*Iron aesculus* (Imanishi); Sinitshenkova, 1978: 50 (larva, imago; FE Russia); Tshernova et al., 1986: 120 (imago; FE Russia).

*Epeorus (Iron) aesculus* Imanishi; Kluge & Tiunova, 1989: 8 (larva, imago; FE Russia); Kluge, 1997: 206 (larva; FE Russia).

*Iron koreanicus* Braasch & Soldan, 1988: 25 (larva; N Korea), syn. n.

Material examined. Larvae, imagines and imagines reared from larvae (FE Russia, N Korea, S Korea; SPbU, SWU).

Originally *E. aesculus* was described from imagines and two forms of larvae tentatively attributed to this species (Imanishi, 1934). Sinitshenkova (1978) redescribed imagines and true larvae of *E. aesculus*, and distinguished it from *Iron maculatus* Tshernova, 1949. Kluge & Tiunova (1989) gave an additional description of this species. Soldan (pers. comm.) recently agreed that *Iron koreanicus* is conspecific with Kluge & Tiunova's (1989) concept of E. (I.) *aesculus*.

Family EPHEMERELLIDAE

**Ephemerella** (Cincticostella) *levanidovae* Tshernova, 1952

*Ephemerella levanidovae* Tshernova, 1952: 274 (larva, FE Russia).

*Ephemerella orientalis* Tshernova, 1952: 279 (imago; FE Russia) (synonymy established by Tshernova et al., 1986: 138).

*Ephemerella (Cincticostella) levanidovae* Tshernova: Allen, 1971: 516 (larva, FE Russia); Tshernova et
Ephemeralidae (Cincticostella) castanea Allen, 1971: 514
(larva; S Korea), syn. n.
Cincticostella castanea (Allen): Yoon & Bae, 1988b: 29
(larva, imago; S Korea).

Material examined. Lectotype and paralectotypes (larvae) of Ephemerella levandovae Tshernova, 1952 (FE Russia; ZIN). Larvae, imagines, and imagines reared from larvae (FE Russia, S Korea; SPbU, SWU).

We recognize this synonymy based on a good series of reared material of E. (C.) levandovae and E. (C.) castanea from the type localities in the Far East of Russia and in Korea respectively. This species commonly occurs in clean mountain streams.

Ephemeralidae (Drunella) solida Bajkova, 1980

Ephemeralidae triospina n. a: Imanishi, 1940: 193 (larva; N Korea).
Ephemeralidae solida Bajkova, 1980: 796 (larva; FE Russia).
Ephemeralidae (Drunella) solida (Bajkova): Tshernova et al., 1986: 140 (imago; FE Russia); Kluge, 1997: 210 (larva; FE Russia).
Drusella solida (Bajkova): Tiunova, 1978: 7 (FE Russia); 1988: 5 (imago; FE Russia).

Material examined. Larvae, imagines, and imagines reared from larvae (FE Russia, N Korea, S Korea; SPbU, SWU).

Previously the species described by Imanishi (1940) under arbitrary name "Ephemeralidae triospina n. a" was incorrectly associated with Ephemeralidae triacantha by Tshernova (1952). E. (D.) solida is distinguished from E. (D.) triacantha by the presence of stout setae on fore femora, lack of a longitudinal ridge on fore femora, and distinct colour pattern on thorax and abdomen. Previously, this species has been frequently misidentified as E. (D.) triacantha in faunistic studies in Korea.

Ephemeralidae (Drunella) triacantha Tshernova, 1949

Ephemeralidae triospina n. a: Imanishi, 1940: 194 (larva; N Korea).
Ephemeralidae triacantha Tshernova, 1949: 151 (larva; Altai).
Ephemeralidae (Drunella) triacantha (Tshernova): Edmunds, 1959: 546; Tshernova et al., 1986: 139 (imago; FE Russia); Kluge, 1997: 210 (larva; FE Russia).
Ephemeralidae (Drunella) triacantha Ueno: Yoon & Kim, 1981: 37 (S Korea).
Drusella triacantha (Tshernova): Yoon & Bae, 1988a: 166 (larva, imago; S Korea).

Material examined. Larvae, imagines, and imagines reared from larvae (FE Russia, N Korea, S Korea; PSU, SWU) (lectotype and paralectotype larvae of E. tenax Tshernova, 1952 (FE Russia; ZIN).

See discussion under E. (D.) solida, above.

Ephemeralidae (Ephemeralidae) dentata Bajkova, 1967

Ephemeralidae dentata Bajkova, 1967: 331 (larva; FE Russia); Kluge, 1995: 40 (type deposition).
Ephemeralidae (Ephemeralidae) keijoensis Allen, 1971: 526 (larva; S Korea), syn. n.
Ephemeralidae (Ephemeralidae) dentata Bajkova: Kluge, 1997: 212 (larva; FE Russia).

Material examined. Holotype (larva) of E. dentata Bajkova, 1967 (FE Russia; ZIN). Larvae (FE Russia; SPbU) and imagines reared from larvae (S Korea; SWU)

Based on the examination of type material of E. dentata and a good series of reared material of E. (D.) keijoensis from the type locality (Seoul, Korea), we established the above synonymy.

Ephemeralidae (Ephemeralidae) kozhovi Bajkova, 1967

Ephemeralidae nba: Imanishi, 1940: 202 (larva; N Korea) (associated with E. notofascia by Yoon & Bae, 1988b).
Ephemeralidae kozhovi Bajkova, 1967: 327 (larva, imago; FE Russia); Kluge, 1995: 40.
Ephemeralidae (Ephemeralidae) kozhovi Bajkova: Tshernova et al., 1986: 138 (imago; FE Russia); Kluge, 1997: 212 (larva; FE Russia).
Ephemeralidae notofascia Yoon & Bae, 1988b: 34 (larva; S Korea), syn. n.

Material examined. Holotype and paratypes (imagines and larvae) of E. kozhovi Bajkova, 1967 (FE Russia; ZIN). Holotype and paratypes (larvae) of E. notofascia Yoon & Bae, 1988 (S Korea; SWU). Larvae, imagines and imagines reared from larvae (FE Russia, S Korea; SPbU, SWU).

We establish the above synonymy by comparison of the type specimens of both species.

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