STATUS OF THE KNOWLEDGE OF EPHEMEROPTERA IN NORTHEAST ASIA AND GUIDELINES FOR FUTURE RESEARCH

Yeon Jae Bae

Department of Biology
Seoul Women's University
Seoul 139-774, Korea

ABSTRACT

Mayfly studies in Northeast Asia are summarized from a historical perspective. The number of known Ephemeroptera taxa, major bibliographic sources, and current mayfly workers are provided. Future research guidelines are additionally discussed.

OVERVIEW

Northeast Asia may be defined by the region encompassed by the Baykal lake, Mongolian dry lands, and the Huang river in China, including Northeastern China, Russian Far East, Korean peninsula, and Japanese islands (Bae, 1997). Systematists, biogeographers, and ecologists have being attracted to this fauna rich region since long time ago.

Systematic studies of Ephemeroptera in this region have been started by Japanese workers early in this century although there were some pioneer investigations by European workers (e.g., McLachlan, 1875). Ueno (e.g., 1928) and Imanishi (1930-1938) have made major systematic works in Japan. Gose (1979-1980, 1985) prepared larval and adult keys to Japanese species of mayflies, which are still in use in Japan. There have been 101 species of mayflies in 12 families known in Japan (Table 1).

In Far East Russia (FE Russia), Tshernova (e.g., 1952), Bajkova (e.g., 1972), and Kluge (e.g., 1983) have dealt with FE Russian fauna. Tshernova et al. (1986) and Kluge (1997) prepared adult and larval keys to FE Russian mayflies, respectively. So far, 149 species of mayflies in 17 families have been known in FE Russia (Table 1).

Korean mayfly fauna has been investigated mainly by Yoon and Bae (e.g., 1988); and a larval key (Yoon, 1995) has been available. More taxonomic investigations on the Baetidae of Korea (Park et al., 1996; Bae and Park, 1997, 1998; Bae et al., 1998) and North Korean mayfly fauna (Bae and Soldan, 1997; Bae and Andrikovics, 1997) have been carried out relatively recently. There have been 75 species of mayflies in 12 families known in Korea (Table 1).

Trends in Research in Ephemeroptera and Plecoptera
Edited by E. Dominguez, Kluwer Academic/Plenum Publishers, 2001

Table 1. Number of Ephemeroptera taxa recorded from Northeast Asian countries

Family	Japan	FE Russia	Korea	NE China
Acanthametropodinae	0	1	0	0
Ameletidae	8	7	2	2
Ametropodidae	0	1	0	0
Baetidae	23	30	15	4
Behningiidae	0	2	0	0
Caenidae	1	12	0	0
Ephemerellidae	25	20	16	10
Ephemeridae	4	9	4	4
Heptageniidae	24	45	24	11
Isonychiidae	1	2	2	0
Leptophlebiidae	6	6	2	1
Metretopodidae	0	2	1	0
Neoephemeridae	0	1	1	1
Oligoneuriidae	1	1	0	0
Polymitarcyidae	3	2	1	1
Potamanthidae	2	2	4	1
Siphlonuridae	3	6	3	3
Species total	101	149	75	38
Genus total	32	42	32	18
Family total	12	17	12	10
Species grand total				232
Genus grand total				47
Family grand total				17

Mayfly fauna of Northeastern China is currently under investigation by Bae and Liu (1999). So far, 38 species of mayflies in 10 families have been recognized from the area, but more species will be described in the near future.

It has been argued that taxonomic comparisons are necessary between Northeast Asian countries (e.g., Bae et al., 1998). Regional revisions are being conducted in some groups of mayflies (e.g., Chun and Bae: Heptageniidae; Park and Bae: Baetidae). Bae (1997) reviewed mayfly systematics in Northeast Asia from a historical perspective, which contained comprehensive bibliographic sources. Bae et al. (1999) reviewed Imanishi's (1940) report on larval Ephemeroptera which is the first monographic work covering almost all the areas in Northeast Asia.

From the ecological and environmental perspectives, larval mayflies have been the major interest not only in the analysis of communities of aquatic insects or benthic macroinvertebrates but also in the use of biological indicators in stream ecosystems (see, Bae, 1992, 1996). Hundreds of streams and rivers have been investigated for environmental purposes especially in Japan and Korea (see Bae, 1996).

It must be, however, notify that population level ecological approaches, e.g., life history and habitat adaptation, trophic and behavioral ecology, etc., are very wanting although some important groups such as *Ephemera* (e.g., Takemon, 1990; Lee et al., 1999), *Potamanthus* (e.g., Watanabe, 1989), and *Ephoron* (e.g., Watanabe et al., 1999), are recently under investigation.

Mayfly workers in Northeast Asian region are listed in Table 2. More mayfly scientists in diverse fields are needed in the future.

Table 2. Current mayfly workers who reside in Northeast Asia

Name	Institution	Status	Area interest*
Japan			
K. Gose		Retired	1
N. C. Watanabe	Kagawa Univ.	Professor	2, 3
S. I. Ishiwata	Kanagawa Env.Res.Center	Researcher	1, 3
Y. Takemon	Osaka Pref. Univ.	Professor	2, 3
N. Kobayashi	Asahi Tech. Inst.	Researcher	1, 3
FE Russia			
O. Ja. Bajkova		Retired	1
T. Tiunova	Russian Acad. Sci., Vladivostok	Researcher	1, 2
Korea			
I. B. Yoon	Korea Univ.	Professor	1, 2, 3
Y. J. Bae	Seoul Women's Univ.	Professor	1, 2, 3
D. J. Chun	Korean Entomol. Inst.	Researcher	1
S. J. Lee	Korea Univ.	PhD student	2
S. Y. Park	Seoul Women's Univ.	Researcher	1
J. M. Hwang	Seoul Women's Univ.	MS student	1
NE China			
G. C. Liu	Shenyang Agr. Univ.	Professor	1, 3
Y. T. Quan	Harbin Agr. Univ.	Professor	1

*1: Systematics, 2: Ecology, 3: Environment.

ACKNOWLEDGMENTS

This work was supported by GRANT No 961-0585-063-2 from the Korea Science and Engineering Foundation.

REFERENCES

Bae, Y. J. 1992. Current research and methods in aquatic entomology with special reference to mayfly studies. '92 Symp. Proc. Korean Soc. Limnol. p. 9-32. (in Korean).

Bae, Y. J. 1996. Current status and problems of aquatic insect research in Korea. '96 Symp. Proc. Korean Soc. Limnol. p. 63-71. (in Korean).

Bae, Y. J. 1997. A historical review of Ephemeroptera systematics in Northeast Asia. p. 405-417 In: P. Landolt and M. Sartori (eds). Ephemeroptera & Plecoptera: Biology-Ecology-Systematics. MTL, Fribourg, Switzerland.

Bae, Y. J. and S. Andrikovics. 1997. Mayfly (Ephemeroptera) fauna of North Korea (2). Insecta Koreana 14: 153-160.

Bae, Y. J., N. Ju. Kluge and D. J. Chun. 1998. New synonymy and new distributional data of mayflies from Korea and Russian Far East (Ephemeroptera). Zoosyst. Rossica. 7: 89-94.

Bae, Y. J., J. E. Lee and I. B. Yoon. 1999. Review of Imanishi's (1940) report on the Ephemeroptera in Northeast Asia. Ent. Sci. (Submitted.)

Bae, Y. J. and G. C. Liu. 1999. Mayflies (Ephemeroptera) from Zhiangbeisan area in Northeast Asia. Ent. Res. Bull. (KEI), Seoul. (In press.)

Bae, Y. J. and S. Y. Park. 1997. Taxonomy of *Cloeon* and *Procloeon* (Ephemeroptera: Baetidae) in Korea. Korean J. Syst. Zool. 13: 303-314.

Bae, Y. J. and S. Y. Park. 1998. *Alainites*, *Baetis*, *Labiobaetis*, and *Nigrobaetis* (Ephemeroptera: Baetidae) in Korea. Korean J. Syst. Zool. 14: 1-12.

Bae, Y. J. and T. Soldan. 1997. Mayfly (Ephemeroptera) fauna of North Korea (1). Insecta Koreana 14: 137-152.

Bajkova, O. Ja. 1972. On the mayflies of the Amur basin: I. Imagines (Ephemeroptera: Ephemerellidae). Izv. Tikhookean. Nauchn. Issled Inst. Rybn. Khoz. Okeanogr. 77: 178-206. (in Russian).

Gose, K. 1979-80. The mayflies of Japan. Aquabiol. (Japan) (Reference sources various). (in Japanese).

Gose, K. 1985. Ephemeroptera. In: Kawai, T (ed.) An illustrated book of aquatic insects of Japan, pp. 7-32, Tokai Univ. Press, Tokyo. (in Japanese).

Imanishi, K. 1930-38. Mayflies from Japanese torrents. I-IX. (Reference sources various).

Imanishi, K. 1940. Ephemeroptera of Manchoukuo, Inner Mongolia, and Chosen. pp. 169-263 In: Kawamura, T. (Ed.) Report of the limnological survey of Kwantung and Manchoukuo. Kyoto. (in Japanese).

Kluge, N. Ju. 1983. New and little known mayflies of the Far East SSSR. Gen. *Ecdyonurus* Etn. (Ephemeroptera, Heptageniidae). Ekol. Sist. Presn. Organ. Dal. Vost. pp. 27-36. (in Russian).

Kluge, N. Ju. 1997. Order Ephemeroptera. p. 116-220 In: S. J. Tshalolikhin (ed.) Key to freshwater invertebrates of Russia and adjacent lands. St. Petersburg.

Lee, S. J., Y. J. Bae, I. B. Yoon and N. C. Watanabe. 1999. Comparisons of temperature related life histories in two ephemerid mayflies (*Ephemera separigata* and *E. strigata*: Ephemeridae, Ephemeroptera, Insecta) from a mountain stream in Korea. Korean J. Limnol. (in press).

McLachlan, R. 1875. A sketch of our present knowledge of the neuropterous fauna of Japan (excluding Odonata and Trichoptera). Trans. ent. Soc. London. pp. 167-190.

Park, S. Y., Y. J. Bae and I. B. Yoon. 1996. Revision of the Baetidae (Ephemeroptera) of Korea. (1) Historical review, *Acentrella* Bengtsson and *Baetiella* Ueno. Ent. Res. Bull., KEI, Seoul 22: 55-66.

Takemon, Y. 1990. Timing and synchronicity of the emergence of *Ephemera strigata*. pp. 61-70 In: I. C. Campbell (Ed.) Mayflies and stoneflies. Kluwer Academic Publ.

Tshernova, O. A. 1952. Mayflies (Ephemeroptera) of the Amur river basin and adjacent waters and their role in the nutrition of Amur fishes. Tr. Amurskoy Ichtiol. Ekspeditsii 3: 229-360. (in Russian).

Tshernova, O. A., N. Ju. Kluge, N. D. Sinitshenkova and V. V. Belov. 1986. Order Ephemeroptera. pp. 99-142 In: Ler, P.A. (ed.) Identification of insects of Far East USSR. Vol. 1, Leningrad Press, Leningrad. (in Russian).

Ueno, M. 1928. Some Japanese mayfly nymphs. Mem. Coll. Sci., Kyoto Imp. Univ., Kyoto 4: 19-63.

Watanabe, N. C. 1989. Seasonal and diurnal changes in emergence of *Potamanthodes kamonis* in a stream of central Japan (Ephemeroptera: Potamanthidae). Jap. J. Limnol. 50: 157-161.

Watanabe, N. C., I. Mori and I. Yoshitaka. 1999. Effect of water temperature on the mass emergence of the mayfly, *Ephoron shigae*, in a Japanese river (Ephemeroptera: Polymitarcyidae). Freshw. Biol. 41: 537-541.

Yoon, I. B. and Y. J. Bae. 1988. I. Order Ephemeroptera. pp. 95-184 In: Yoon, I.B. Illustrated encyclopaedia of animals and plants of Korea. Vol. 30. Animals (Aquatic Insects), Ministry of Education, Korea. (in Korean).

Yoon, I. B. 1995. An Illustrated Key Book of Aquatic Insects of Korea. Jung Hang Sa, Seoul. (in Korean).