

Mayflies (Ephemeroptera) from Changbaishan Area in Northeast Asia

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ABSTRACT : An investigation of mayflies from Changbaishan area in Northeast Asia resulted in the recognition of thirty-three species of mayflies in seven families, including eight undetermined species. Information on the habitats and materials was provided; and some taxonomic and distributional aspects were discussed.

Key words : Mayflies, Ephemeroptera, Systematics, Fauna, Changbaishan, Northeast Asia

INTRODUCTION

Paektusan-Changbaishan area is located on the border between Korea (Paektu Mt. in North Korean side) and China (Changbai Mt. in Chinese side) in Northeast Asia (Fig. 1). Since it originated from recent volcanic activities, the land is relatively elevated (highest peak 2,744 m) and the soil is consist of mainly volcanic rocks. The area has been known the largest and best preserved area in Northeast Asia.

Mayfly fauna from the area has not been well known until recent years. Imanishi (1940) recorded some species of mayfly larvae from North Korea and Manchuria, but the localities were not close enough to Paektusan-Changbaishan area. Braasch and Soldán (1988), Bae and Soldán (1997), and Bae and Andrikovics (1997) included some mayflies from Paektusan area in their North Korean mayfly study.

As part of a revisionary study of the Ephemeroptera in Northeast Asia (see Bae, 1997), the authors have an opportunity to collect mayfly materials from Changbaishan area in Northeast Asia which has not been investigated. We herein

report all the species of mayflies and information on localities and habitats although part of the species are left undetermined for further studies.

MATERIALS AND METHODS

Field samplings were taken from June 1 to June 4 in 1997 at sixteen sites from the tributaries of the Songhua River and the Tumen River in Changbaishan area (Fig. 1) which belong to Jilin Province in China. Larvae were qualitatively collected by hand nets and preserved in 80% Ethanol. Various larval habitats such as riffles, pools, vegetation, etc. were checked for larvae. Adults were additionally collected by a sweeping net. At each site, the sampling endured for 20~60 minutes (average 30 mim) depending on the habitat condition.

Collecting Sites

St. A: Toudaobaihe R., Antu, Jilin: Collecting date and time June 3, 1997 3:20~4:20 pm.

Main stream of Toudaobaihe R. at high bridge; stream width 50~80 m; water width 50 m; depth 20~200 cm; transparency medium; current fast; water temperature ca. 15°C; substrate composition boulder 20%, cobble 40%, pebble 20%, gravel 15%, sand 5%, silt negligible. Water level

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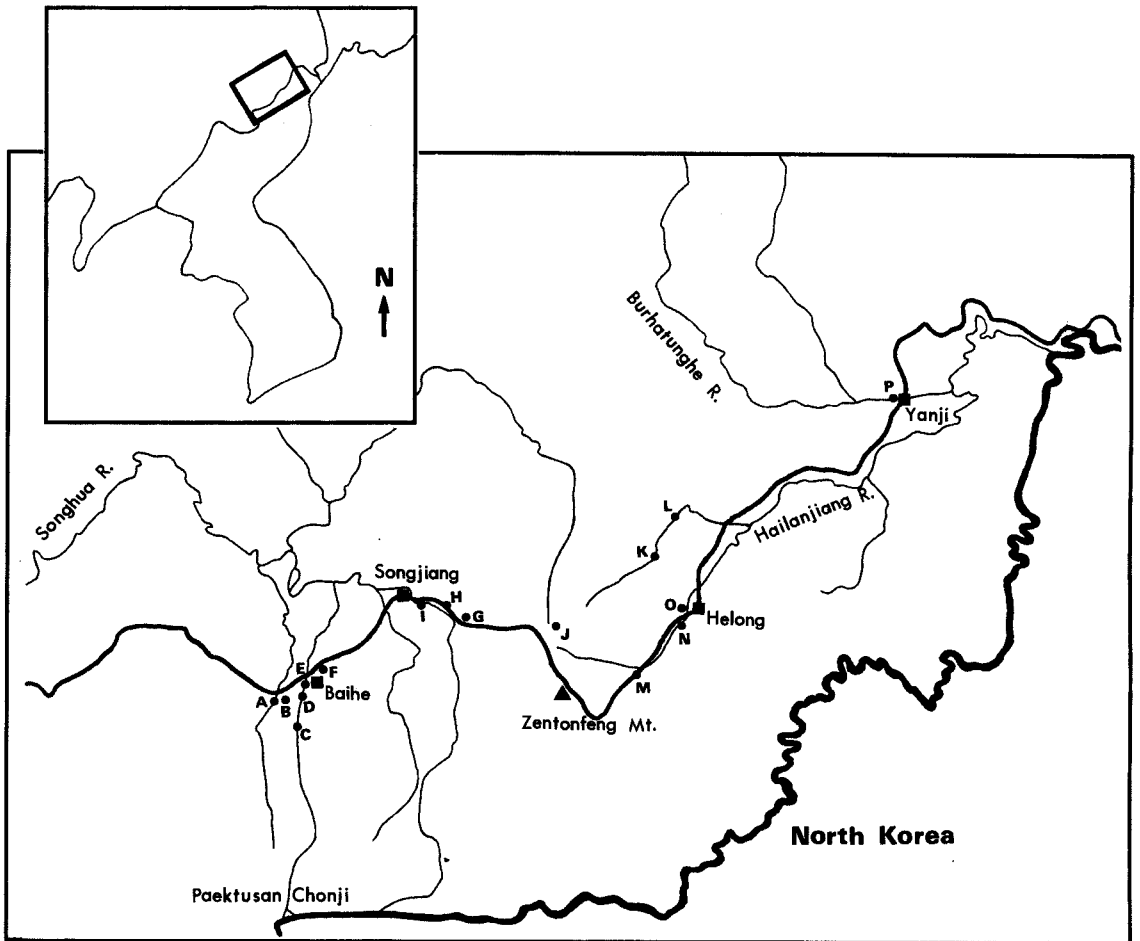


Fig. 1. Collecting sites from the Changbaishan area in Northeast Asia.

was increased due to rain.

St. B: Small stream near Toudaobaihe R., Antu, Jilin; Collecting date and time June 3, 1997 2:20~2:45 pm.

A small branch stream near Toudaobaihe R. at bridge; stream width 15 m; water width 5 m; depth 10~30 cm; transparency high; current moderately fast; water temperature ca. 18°C; substrate composition boulder 20%, cobble 40%, pebble 20%, gravel 10%, sand 10%, silt negligible. Water level was increased due to rain.

St. C: Erdaobaihe R. at 15 km upstream from Baihe village, Antu, Jilin; Collecting date and time June 3, 1997 11:00~11:40 am.

Main stream of Erdaobaihe R. at ca. 15 km

upstream from Baihe village at electric power dam; stream width 30 m; water width 5~10 m; depth 5~30 cm; transparency medium; current moderately fast; water temperature ca. 15°C; substrate composition boulder 20%, cobble 15%, pebble 40%, gravel 20%, sand 5%, silt negligible. Samples were taken at a riffle area below dam and at ponds beside the stream. Ponds were 10~30 m wide and long, 10~30 cm deep, with silty substrate, and with abundant macrophytes marginally.

St. D: Erdaobaihe R. at 2 km upstream from Baihe village, Antu, Jilin; Collecting date and time June 3, 1997 12:30~12:50 pm.

Main stream of Erdaobaihe R. at ca. 2 km up-

stream from Baihe village at dam; stream width 30 m; water width 10 m; depth 5~30 cm; transparency medium; current moderately fast; water temperature ca. 15°C; substrate composition boulder 20%, cobble 30%, pebble 15%, gravel 20%, sand 10%, silt 5%; attached algae abundant. Water level was low due to diversion.

St. E: Erdaobaihe R. at Baihe village, Antu, Jilin; Collecting date and time June 2, 1997 4:00~5:00 pm.

Main stream of Erdaobaihe R. at Baihe village near Beauty Pine Hotel; stream width 50 m; water width 30 m; depth 20~150 cm; transparency medium; current fast; water temperature ca. 13°C; substrate composition boulder 10%, cobble 40%, pebble 20%, gravel 20%, sand 10%, silt negligible. Water level was increased due to rain.

St. F: Small stream at 1 km east of Baihe village, Antu, Jilin; Collecting date and time June 2, 1997 12:45~1:05 pm.

A small stream at ca. 1 km east of Baihe village at a bridge on the road from Songjiang village to Baihe village; stream width 5 m; water width 3 m; depth 20~40 cm; transparency high; current moderately fast; water temperature ca. 15°C; substrate composition boulder 30%, cobble 60%, pebble 10%, gravel, sand, and silt negligible. Samples were taken from riffle and pool areas. In the pool area, silty and sandy substrates were dominant with macrophytes.

St. G: Sandao, Antu, Jilin; Collecting date and time June 2, 1997 11:00~11:20 am.

A stream at Sandao village, west of Zentoufeng mountain (1677 m); stream width 20 m; water width 10 m; depth 20~60 cm; transparency high; current fast; water temperature ca. 15°C; substrate composition boulder 20%, cobble 40%, pebble 20%, gravel 10%, sand 10%, silt negligible. Water level was increased due to rain.

St. H: Branch stream at 2 km east of Sandao village, Antu, Jilin; Collecting date and time June 4, 1997 8:50~9:10 am.

A branch stream at Sandao Br. at 2 km east of Sandao village; stream width 20 m; water width 15 m; depth 20~30 cm; transparency medium; current fast; water temperature ca. 15°C; substrate composition boulder 20%, cobble 30%, pebble 10%, gravel 10%, sand 30%, silt negligi-

ble. Water level was increased and sand was abundantly deposited due to rain.

St. I: Sidaobaihe R. at 3 km west of Songjiang village, Antu, Jilin; Collecting date and time June 2, 1997 12:10~12:30 pm.

Main stream of Sidaobaihe R. at bridge on the road from ca. 3 km west of Songjiang village; stream width 50 m; water width 30 m; depth 10~150 cm; transparency medium; current moderately fast; water temperature ca. 17°C; substrate composition cobble 10%, pebble 20%, gravel 30%, sand 30%, silt 10%. Water level was increased due to rain.

St. J: Headwater stream at mountain pass from Sandao village to Wolong village, Helong, Jilin; Collecting date and time June 4, 1997 10:00~10:40 am.

A headwater stream at top of mountain pass from Sandao village to Wolong village, north of Zentoufeng mountain; stream width 3~4 m; water width 2~3 m; depth 10~30 cm; transparency high; current fast; water temperature ca. 10°C; substrate composition boulder 10%, cobble 20%, pebble 40%, gravel 20%, sand 10%, silt negligible; attached algae abundant. Water level was increased due to rain. The collecting site was not covered with canopy because it was located beside the road.

St. K: Xianfeng village, Wolong, Jilin; Collecting date and time June 4, 1997 11:00~11:30 am.

Main stream of Erdao R. at bridge of Xianfeng village, east of mountain pass between Sandao village and Wolong village; stream width 20~30 m; water width 10~15 m; depth 20~40 cm; transparency high; current fast; water temperature ca. 13°C; substrate composition boulder 20%, cobble 30%, pebble 20%, gravel 20%, sand 10%, silt present; attached algae present. Water level was increased due to rain.

St. L: Wolong village, Jilin; Collecting date and time June 4, 1997 12:00~12:20 pm.

Main stream of Erdao R. at Wolong village; stream width 50~80 m; water width 20~30 m; depth 20~50 cm; transparency medium; current fast; water temperature ca. 15°C; substrate composition boulder 20%, cobble 20%, pebble 30%, gravel 20%, sand 10%, silt negligible. Water level was increased due to rain. The land beside stream was rice field and other cultivated area.

St. M: Qingshanli village, Helong, Jilin; Collecting date and time June 1, 1997 3:00~4:00 pm.

Branch stream of Hailanjiang R. at 1 km upstream of Qingshanli village; stream width 5 m; water width 5 m; depth 10~40 cm; transparency medium; current fast; water temperature ca. 8 °C; substrate composition boulder 10%, cobble 40%, pebble 30%, gravel 10%, sand 10%, silt present; attached algae (green color) abundant. Water level was increased due to rain. The site was located beside road at a small tunnel bridge and it was completely covered with canopy.

St. N: Main stream of Hailanjiang R. at Songxiaping village, Helong, Jilin; Collecting date and time June 1, 1997 4:30~5:00 pm.

Main stream of Hailanjiang R. at 1 km west of Songxiaping village; stream width 50 m; water width 30 m; depth 10~50 cm; transparency low; current fast; water temperature ca. 10 °C; substrate composition boulder 10%, cobble 30%, pebble 20%, gravel 10%, sand 10%, silt 20%; organic matter abundant on bottom. Water level was increased due to rain.

St. O: Branch stream of Hailanjiang R. at Songxiaping village, Helong, Jilin; Collecting date and time June 1, 1997 5:10~5:30 pm.

A branch stream of Hailanjiang R. at bridge in Songxiaping village; stream width 20 m; water width 10 m; depth 10~40 cm; transparency medium; current fast; water temperature ca. 10 °C; substrate composition boulder 10%, cobble 40%, pebble 20%, gravel 10%, sand 10%, silt 10%; organic matter present on bottom. Water level was increased due to rain.

St. P: Yanji city, Jilin; Collecting date and time June 4, 1997 3:00~4:00 pm.

Main stream of Burhatonghe R. at Yanji city at 300 m upstream from Yanxinqiao (Br.) at north side of the stream; stream width 250~300 m; water width 50~100 m; depth 20~200 cm; transparency very low (yellow); current moderately fast; water temperature ca. 17 °C; substrate composition cobble 10%, pebble 10%, sand and silt (mud) 80%; aquatic macrophytes abundant. Water level was increased due to rain.

LIST OF SPECIES

Family Ameletidae

1. *Ameletus montanus* Imanishi

Materials examined: A: 1M & 20L; C: 5L; D: 3L; E: 19L; G: 107L; H: 1L; J: 2L; M: 29L; N: 9L.

2. *Ameletus* sp. 1

Materials examined: J: 13L; M: 6L; N: 1L.

Family Baetidae

3. *Baetis fuscatus* (Linnaeus)

Materials examined: P: 1M, 1F & 63L.

4. *Baetis pseudothermicus* Kluge

Materials examined: B: 46L; C: 88L; D: 5L; E: 11L; G: 163L; J: 1L; K: 100L; M: 12L.

5. *Labiobaetis* sp. 1

Materials examined: P: 6L.

6. *Procloeon pennulatum* (Eaton)

Materials examined: P: 3L.

Family Ephemerellidae

7. *Cincticostella levanidovae* Tshernova

Materials examined: A: 12L, 5 Ms & 5 Fs; G: 8L; H: 2L; I: 1L; L: 1L.

8. *Cincticostella tshernovae* Bajkova

Materials examined: A: 1M, 2Ms & 8 Fs.

9. *Drunella aculea* (Allen)

Materials examined: E: 1L; F: 6L; G: 8L; H: 4L; J: 2L; L: 1L; N: 32L; O: 8L.

10. *Drunella criptomera* (Imanishi)

Materials examined: F: 1L.

11. *Drunella lepnevae* (Tshernova)

Materials examined: A: 3L; C: 18L; D: 47L; E: 214L; G: 2L; O: 1L.

12. *Drunella triacantha* (Tshernova)

Materials examined: D: 1L.

13. *Drunella solida* Bajkova

Materials examined: G: 1L.

14. *Ephemerella aurivillii* (Bengtsson)

Materials examined: A: 1M & 1Ms; C: 5L; E:

10L; G: 5L; J: 18L; K: 1L; M: 20L; O: 2L.

15. *Ephemerella dentata* Bajkova

Materials examined: A: 2L; D: 4L; E: 7L; G: 234 L; I: 7L; J: 1L; L: 25L; N: 125L; O: 13L; P: 1L.

16. *Ephemerella kozhovi* Bajkova

Materials examined: C: 2L; D: 1L; E: 6L; F: 1L.

Family Ephemeridae

17. *Ephemera separigata* Bae

Materials examined: A: 3F; F: 10L; G: 10L.

18. *Ephemera strigata* Eaton

Materials examined: F: 3L.

Family Heptageniidae

19. *Cinygmula brunnea* Tiunova

Materials examined: C: 4L; D: 3L; G: 10L; K: 16L; M: 25L.

20. *Cinygmula hirasana* (Imanishi)

Materials examined: A: 3L; C: 35L; D: 19L; E: 10L; G: 95L; H: 13L; K: 35L; L: 11L; M: 25L; N: 7L.

21. *Cinygmula kurenzovi* (Bajkova)

Materials examined: A: 2L; C: 18L; D: 10L; E: 5L; G: 43L; H: 7L; K: 18L; L: 6L; M: 13L; N: 4L.

22. *Cinygmula levanidovi* Tshernova

Materials examined: A: 1L; C: 9L; D: 5L; E: 3L; G: 24L; H: 4L; K: 9L; L: 3L; M: 7L; N: 2L.

23. *Ecdyonurus kibunensis* Imanishi

Materials examined: A: 1L; F: 3L.

24. *Ecdyonurus* sp. 1

Materials examined: B: 5L.

25. *Epeorus curvatulus* Matsumura

Materials examined: F: 1L.

26. *Epeorus pellucidus* (Brodsky)

Materials examined: A: 103L; F: 10L; G: 20L; H: 3L; I: 25L; L: 3L.

27. *Heptagenia sulphurea albicauda* Kluge

Materials examined: P: 1L.

28. *Heptagenia* sp. 1

Materials examined: F: 29L.

29. *Iron aesculus* (Imanishi)

Materials examined: A: 1L; C: 19L; D: 13L; E: 1L; G: 32L; K: 78L; N: 2L; O: 1L.

Family Leptophlebiidae

30. *Paraleptophlebia* sp. 1

Materials examined: A: 1L; G: 2L; L: 1L; M: 3L.

Family Siphonuridae

31. *Siphonurus* sp. 1

Materials examined: A: 16L; C: 24L; E: 53L; F: 11L; L: 11L.

32. *Siphonurus* sp. 2

Materials examined: P: 6L.

33. *Siphonurus* sp. 3

Materials examined: N: 2L.

DISCUSSION

Since the sampling sites were situated on relatively high lands, temperature was normally lower than that of low lands. The weather was mostly cloudy for the sampling period and it had rained for some days previously. Because of these reasons, adult mayflies were not effectively collected from the sampling sites, except for the site A.

Relatively fewer species of mayflies occurred from the area comparing with those of such nearby place as North Korea (Bae and Soldán, 1997; Bae and Andrikovics, 1997). This may be caused by the recent origin of the land as well as by relatively shorter sampling period in a limited area.

Among the mayfly taxa from the area, Ephemerellidae (30.3%) and Heptageniidae (33.3%), which are generally abundant in the mountain streams in northern temperate regions, were the major groups, and *Drunella* and *Cinygmula* were most diverse. *Ameletus montanus*, *Drunella aculea*, *D. lepnevae*, *Ephemerella dentata*, and

Cinygmula hirasana were particularly abundant. Almost all the species from Changbaishan area are overlapping with the species occurring in Russian Far East, Korea, and Japan (see Bae, 1997).

Although mayfly larvae are often more useful in the identification (Bae *et al.*, 1999), part of the materials from the study area were not determined to species because of the lack of information. Part of them are regarded endemic to the area (e.g., *Labiobaetis* sp. 1 and *Heptagenia* sp. 1) or closely related to the species previously known from Northeast Asia (e.g., *Ameletus* sp. 1, *Siphonurus* sp. 1, and *Siphonurus* sp. 2) and the others are too immature to determine the species (e.g., *Ecdyonurus* sp. 1, *Paraleptophlebia* sp. 1, and *Siphonurus* sp. 3).

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국문적요 : 長白山 地域의 하루살이. 裴淵宰, 劉廣純¹ (서울女子大學校 生物學科 ¹沈陽農業大學校 植物保護系) 동북아시아 장백산 지역에서의 조사를 통하여 7과 33종 (미동정종 8종 포함)의 하루살이를 확인하였다. 조사 지점의 서식처와 표본에 관한 정보를 기록하였고, 분류 및 분포에 관한 특성을 간략히 논하였다.

검색어 : 하루살이, 하루살이목, 분류, 동물상, 장백산, 동북아시아