

Limnophila crane flies (Diptera: Limoniidae) of Korea

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This study is based on crane fly specimens collected during an 80-year period (1937–2017) in the Republic of Korea and Democratic People's Republic of Korea, and are in collections maintained at the United States National Museum, Smithsonian Institution, Washington DC, USA; the Snow Entomological Museum, University of Kansas, Lawrence, KS, USA; and the National Institute of Biological Resources, Incheon, South Korea. These crane flies are developing in wet places which usually prevail at lower altitudes, but such areas are often used for agriculture and human settlements, making natural habitats scarce and fragmented. Probably because of that, *Limnophila* crane flies are rare on the Korean Peninsula and were unnoticed by previous researchers. The genus *Limnophila* Macquart, 1834 with three species being new record for the Korean Peninsula: *L. (Limnophila) japonica* Alexander, 1913, *L. (L.) pictipennis* (Meigen, 1818) and *L. (L.) politostriata* Alexander, 1934a. General information are presented for each species, such as on genus and subgenus, redescriptions of species based on Korean specimens, illustrations of both sexes, elevation range, period of activity, habitat information, general distribution, and a distribution map for the Korean Peninsula.

Keywords: habitat, larva, new record, North Korea, pupa, South Korea, taxonomy

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DOI:10.12651/JSR.2022.11.2.117

INTRODUCTION

Investigations of Limoniidae (Diptera) crane flies on the Korean Peninsula was initiated by S. Podenas and H.-W. Byun in 2012. Subsequently, crane flies were collected annually at different localities and different seasons using various collection methods. The aim of the study was to document, redescribe, illustrate, and prepare keys for all Korean crane fly species identified to date. This publication is a continuation of previous studies on short-palped crane flies (Limoniidae) from Korea. It includes the genus *Limnophila* Macquart, 1834, which is a new record for the Korean Peninsula.

Limnophila crane flies are developing in wet muddy places at the margins of water pools, in swampy areas or along slow running channels or streams. Such habitats prevail at lower altitudes, along valleys or in flat fields. These places usually are used for agriculture and human settlements, thus natural swampy areas are scarce in densely populated areas with intense agriculture. Despite *Limnophila* crane flies being collected for 80 years on the Korean Peninsula, only 27 specimens were located in scientific collections. Because they are so rare, it is not

surprising that genus was left unnoticed by the Korean entomologists. An additional 50 specimens were added to the collection of the National Institute of Biological Resources by the senior author of this publication.

Photographs of important taxonomical details (e.g., antennae, wings, male and female terminalia) and distribution maps of Korean species are provided.

MATERIALS AND METHODS

Crane flies available for this study (Table 1) are preserved in the following scientific collections:

Specimens collected in 1,937–1,940 in the northern part of the Korean Peninsula (now Democratic People's Republic of Korea [North Korea]) by A.M. Yankovsky are deposited in the collections of the United States National Museum (USNM), Smithsonian Institution, Washington DC, USA;

Specimens collected in 1954 in the southern part of the Korean Peninsula (now Republic of Korea [South Korea]) by Dr G.W. Byers, are deposited in the Snow Entomological Museum, University of Kansas (SMEK), Lawrence,

Table 1. Collecting sites in Korea.

Locality	Year	N*	E*	Collector	Method	Collection
N. Korea, Chonsani Paiktusan	1937	42.00670	128.10650	A. M. Yankovsky	Net	USNM
N. Korea, Seren Mts. (Hamgyeongbuk-do, Gyeongsung-gun)	1938	41.68730	129.30918	A. M. Yankovsky	Net	USNM
N. Korea, Chonsani (Yanggang-do, Daehongdan-gun)	1940	41.99360	128.75250	A.M. Yankovsky	Net	USNM
S. Korea, #3, 7 miles (11 km) West of Chungju	1954	36.62805	127.29126	G. W. Byers	Net	USNM
S. Korea, #14, Oho-ri, east coast	1954	38.33333	128.50000	G. W. Byers	Net	USNM SMEK
S. Korea, Jeollabuk-do, Namwon, Unbong-eup, Hwasu-ri	2013	35.45098	127.57596	S. Podenas	Net	NIBR
S. Korea, Jeollabuk-do, Namwon, Sannae-myeon, Ipseok-ri	2013	35.41021	127.64735	S. Podenas	Net	NIBR
S. Korea, Jeollanam-do, Gurye-gun, Toji-myeon, Naeseo-ri, Piagol valley	2014	35.26590	127.58096	S. Podenas	Net	NIBR
	2015	35.25257	127.58981			
	2016	35.25825	127.58208			
		35.27177	127.57146			
		35.27333	127.56924			
		35.26586	127.58090			
S. Korea, Gyeongsangnam-do, Masanhappo-gu, Jindong-myeon, Dagu-ri	2014	35.11309	128.53067	S. Podenas	Net	NIBR
S. Korea, Gyeonggi-do, Gunpo-si, Suri-dong	2017	37.35022	126.91527	S. Podenas	Net	NIBR

*Coordinates for old collecting sites are approximate

KS, USA and in USNM;

Specimens collected in 2013–2017 in South Korea are deposited in the collections of the National Institute of Biological Resources (NIBR), Incheon, South Korea.

Non-Korean specimens used for comparison: USNM. Lithuanian specimens used for comparison: Vilnius University collection (VU).

Adult crane flies were collected using insect nets, Malaise traps, LED and incandescent black light traps, Mosquito Magnet® traps (Pro Model, Woodstream Corp., Lititz, PA), New Jersey light traps, or at light sources, but all *Limnophila* specimens were captured exclusively with entomological net. Some specimens were preserved dry in envelopes in the field and were later mounted at the laboratory in the Nature Research Centre, Vilnius, Lithuania, on their side on a paper point, with legs generally surrounding the insect pin. Other specimens were preserved in 96% ethanol (EtOH). Wings and antennae of selected specimens were slide mounted in Euparal, genitalia of males and ovipositors of females were cleared overnight in approximately 10% potassium hydroxide (KOH) and preserved in micro vials filled with glycerol on the same pin as the dry insect, or on a separate pin, if the crane fly was preserved in EtOH.

Information of examined material is given exactly as it is on the labels regardless of style, measurement units and other information. Additional labels and additional notes on the same label, such as “metatype” written by Dr. Ch. P. Alexander, who originally described species, are maintained with the corresponding specimen. For specimens collected by S. Podenas and his colleagues, collection

date on the label is followed by the unique collection number in brackets. Different places, where insects were collected on the same date, were given unique collection numbers and all information in the field notes and databases, habitat photographs and other locality information were marked with that number. Specimens are arranged according to the collecting date.

Crane flies were observed using an Olympus SZX10 dissecting microscope. Photographs were taken with a Canon EOS R5 digital camera through a Canon MP-E 65 mm macro lens and through Mitutoyo M Plan Apo 10× and 20× lenses mounted on same camera.

Terminology of adult morphological features generally follows that of Cumming and Wood (2017).

General distribution of species is given according Oosterbroek (2021).

TAXONOMY

Limnophila Macquart, 1834

Limnophila Macquart, 1834: 95; Savchenko, 1983: 49 (Key), 1986: 265–268, 1989: 89, 90.

Poecilostola Schiner, 1863: 222. Type species - *Limnobia pictipennis* Meigen, 1818.

Heteropoecilostola Meunier, 1899: 358. Type species - *Limnophila brevipetiolata* Meunier, 1906 by subsequent designation of Evenhuis (1994: 75).

Limnophila (*Heterolimnophila*) Meunier, 1906: 376 (unjustified emendation of *Heteropoecilostola* Meunier). Type species - *Limnophila brevipetiolata* Meunier,

1906.

Limnomya Rondani, 1861: 11. Type species - *Limnobia pictipennis* Meigen, 1818.

Type species - *Limnobia pictipennis* Meigen, 1818, by subsequent designation of Westwood (1840: 128) (Palearctic).

Adult.

Medium-sized crane fly with body length 8.5–15.2 mm and wing length 8.5–14.5 mm. Body coloration varies from gray to brown and dark brown.

Head: Slightly extended posteriorly, but without neck-shaped prolongation like in *Pseudolimnophila*, or rounded (Figs. 2C, 3B). Vertex wide, width right above base of antenna equals length of scape, vertical tubercle small and rounded, just slightly raised above head surface. Antenna with 14-segmented flagellum (Figs. 1A, 2A), usually short, reaching to frontal margin of prescutum, if bent backwards, sometimes longer. Flagellomeres elongate, usually 3–4 basal segments dilated ventrally, apical segment subequal in length to preceding or exceeds it. Verticils long and distinct, up to twice as long as respective segment.

Thorax: Prothorax distinctly elongate, frontal margin rounded or angulate, without emargination. Mesonotal prescutum with small but distinct tubercular pits, pseudosutural sutures distinct, dark brown or black. Disc of prescutum with four longitudinal stripes, indistinct and dusted in some species (Fig. 2C), polished-black in other (Fig. 3B). Pleuron bare with few scattered indistinct setae along ventral margin of anepisternum. Meron small, thus middle and posterior coxae close to each other. Wing long and narrow, with few large spots at frontal margin and lots of small spots along veins and in most cells (Figs. 1B, 2B, 3A), stigma present. *Arculus* present, vein *Sc* long, reaching wing margin close to the branching point of *Rs*, *sc-r* slightly beyond tip of *Sc*. *R*₁ elongate, *R*₃ and *R*₄ nearly parallel to each other, just slightly diverging at wing margin. Cell *m*₁ long with long stem, length of which usually exceeds that of cell itself. Discal cell always present, elongate. Cross-vein *m-cu* distinctly beyond base, usually close to the middle of discal cell. Anal vein long, slightly sinuous, reaching wing margin close to the level of *Rs* base. Anal angle distinct. Wing cells without macrotrichiae. Wing squama setoseless. All legs with tibial spurs, foreleg with single, middle and posterior legs with two spurs each.

Abdomen: Tergites with distinct paired transverse sutures at about 1/4–1/3 length of sclerite. Male terminalia (Figs. 1C, 2D, 3C) slightly elongate, width does not exceed that of remaining abdominal segments. Sclerites of ninth abdominal segment connected into genital ring in male. Posterior margin of ninth tergite nearly straight or

slightly extended medially with two small, rounded lobes and small emargination between them. Gonocoxite oval or slightly elongate, without ventro-mesal lobe. Some species with fleshy knob-like or sclerotized spine- or claw-shaped apical structure laterally at base of outer gonostylus. Interbase missing. Two pairs of terminal fleshy and setose gonostyli. Outer gonostylus long and narrow, sometimes with sclerotized and hook-shaped apex. Inner gonostylus dilated basally with slightly curved distal part. Aedeagus very long, arched, tube-shaped. Paramere long and narrow, curved medially. Ovipositor (Figs. 1D, 2E, 3D) with long and narrow cerci and hypovalvae, distal part of cercus slightly raised upwards, blunt-apexed, dorsal margin of hypovalva with long parallel setae distally.

Last instar larva.

Body: Covered with brown setae, which gives the body a golden brownish color.

Head capsule: Elongate-oval in shape, depressed dorso-ventrally and reduced. Labrum elongated-oval in shape, separated from clypeus. Frons reduced. Mandible sickle-shaped, with a single sharp, curved apical tooth. Maxilla slightly narrowing toward the tip with apical part directed outward. Maxilla elongated, the length of it almost equal to the 1/3 length of the head capsule. Ventral part of head capsule joined-up with hypopharyngeal bar. Posterior part of head capsule consists of one pair of internolateralia and two pairs of externolateralia, which are weakly sclerotized and less reduced than in other genera of Limnophilinae.

Terminal segment: Spiracular field surrounded by four flattened elongate sclerotized lateral and ventral lobes and a reduced and inconspicuous dorsal lobe. Anus surrounded by four cone-shaped, subequal white and fleshy anal papillae.

Pupa.

Body: Coloration brown.

Head: Cephalic crest inconspicuous, consisting of four unequal lobes. Antennal sheaths short. Respiratory horns elongated, apex slightly flattened and rounded.

Legs: Reaching the end of abdominal segment III.

Abdomen: Segments II–VII with inconspicuous annuli. Tergites and sternites on posterior and anterior parts have transverse rows of small tubercles with spines and few scattered spines in between them. Terminal segment of male blunt and narrow. Terminal segment of female pupa elongate.

A total of 191 extant species belong to *Limnophila* worldwide (Oosterbroek, 2021). They are divided into 14 subgenera: monotypic *L. (Araucolimnophila)* Alexander, 1940 and *L. (Habrolimnophila)* Alexander, 1968a from Neotropics, the most diverse Nearctic fauna with six subgenera: monotypic *L. (Atopolimnophila)* Alexander, 1972 and *L. (Idiolimnophila)* Alexander, 1934b, *L. (Arctolimnophila)* Alexander, 1966 with only two species, *L. (Hesperolimnophila)* Alexander, 1966 with three, *L. (Lasiomastix)*

Osten Sacken, 1860 with four species; subgenus *L. (Dendrolimnophila)* Alexander, 1949 includes one Nearctic and one East Palaearctic species; Afrotropical fauna is characterised by five subgenera: *L. (Dasylimnophila)* Alexander, 1965, that includes two species, *L. (Elporiomyia)* Alexander, 1964, four species, monotypic *L. (Hovalimnophila)* Alexander, 1963, *L. (Nesolimnophila)* Alexander, 1920 with 3 species and 7 species belong to nominative subgenus; subgenus *L. (Indolimnophila)* Alexander, 1968b with 9 species has only Oriental distribution; Oriental fauna also includes one species from nominative subgenus, but same species probably extends also to Palaearctic Region in Japan; the most species-rich nominative subgenus is most diverse in Australia from where 88 species are recorded, it is well represented in Neotropics, 38 species, and 11 species are recorded from Palaearctic. The oldest representative of the genus is known from the Lower Cretaceous Burmese amber. It is ascribed to the separate subgenus *L. (Burmolimnophila)* Podenas, Poinar, 2009. Remaining twenty fossil species are unplaced to subgenera. They all came from Paleogene Period (Evenhuis, 2014). Genus *Limnophila* recorded here for the first time from the Korean Peninsula.

Check list of Korean *Limnophila* crane flies

Limnophila (Limnophila) japonica Alexander, 1913
Limnophila (Limnophila) pictipennis (Meigen, 1818)
Limnophila (Limnophila) politostriata Alexander, 1934a

Key to Korean species of the genus *Limnophila* Macquart

1. Prescutal stripes distinct, polished black (Fig. 3B).
 Wing cell m_1 short, nearly twice as short as its stem (Fig. 3A). Male gonocoxite with apical spine (Fig. 3C).....
Limnophila (Limnophila) politostriata Alexander, 1934a
- Prescutal stripes indistinct, mate gray or brown (Fig. 2C). Wing cell m_1 long, approximately as long as its stem or longer (Figs. 1B, 2B). Male gonocoxite with fleshy apical lobe (Fig. 2D) or simple, without additional structures (Fig. 1C) 2
2. Frontal wing margin with four large spots reaching vein bM or CuA (Fig. 2B), male gonocoxite with fleshy apical lobe (Fig. 2D).....
 *Limnophila (Limnophila) pictipennis* (Meigen, 1818)
- Spots at frontal wing margin small (Fig. 1B), male gonocoxite without additional structures apically (Fig. 1C)
 *Limnophila (Limnophila) japonica* Alexander, 1913

Limnophila (Limnophila) Macquart, 1834

Limnophila (Limnophila) Macquart, 1834: 95; Edwards,

1938: 64 (Key), 84, 85; Ishida, 1959: 3 (Key); Savchenko, Krivolutskaya, 1976: 64; Savchenko, 1983: 53, 1989: 91, 92.

Type species - *Limnobia pictipennis* Meigen, 1818, by subsequent designation of Westwood, 1840: 128 (Palaearctic).

Adult.

Medium-sized crane fly with body length 9.0–15.2 mm and wing length 8.5–14.5 mm. Body coloration gray to brownish.

Head: Extended posteriorly.

Thorax: Wing long and narrow, posterior margin evenly rounded, without angulate extension. Wing area densely spotted, larger spots at frontal margin, numerous small spots along veins and in most cells. Apex of vein Sc nearly transverse, $sc-r$ slightly beyond it. Anal vein arched at wing margin.

Abdomen: Ninth tergite of male abdomen with two rounded lobules at middle of posterior margin. Gonocoxite often armed with strong spine or extended outgrowth apically. Outer gonostylus with simple blunt-apexed or hook-shaped apex. Inner gonostylus setose, often with brush of long setae along basal half of outer margin. Paramere long and slender, distal part turned medially. Aedeagus long, arched and tube-shaped, apex curved downwards. Ovipositor with long and narrow cerci and hypovalvae, distal part of cercus slightly raised upwards, blunt-apexed, dorsal margin of hypovalva with long parallel setae distally.

Subgenus is known from all biogeographical regions except Nearctic with highest diversity in Australia and Neotropics (Oosterbroek, 2021). No fossil species are ascribed to this subgenus (Evenhuis, 2014).

Last instar larva.

Head capsule: In general, very similar to that of other subgenera. Frons well developed and separated from internotalateralia by frontal suture and has acute frontal spine. Antenna short, reaching only half of the mandible length, apical segment short and sculptured, two long setae and three short papillae on the top of basal segment. Mandible bears two teeth at the base.

Abdomen: Segments IV–VII have dorsal and ventral creeping welts. Ventral creeping welts are more prominent than dorsal.

Terminal segment: Ventral pair of spiracular lobes slightly longer than lateral pair. Apical part of each lateral lobe covered with light brown long setae, length of which is almost equal to the length of lobes. Apical part of each ventral lobe covered with long light brown setae, length of which is 2/3 length of lobe. Ventral and lateral lobes covered with pale “U”-shaped sclerites, margin of which is darker than inner part. A small, oval brown sclerite situated at the base of ventral lobe.

Pupa.

Similar to that of the whole genus.

***Limnophila (Limnophila) japonica* Alexander, 1913**

Limnophila (Poecilostola) japonica Alexander, 1913: 316, 317.

Limnophila (Limnophila) japonica Savchenko, Krivoluts-kaya, 1976: 65; Savchenko, 1989: 92.

General. Body coloration: thorax dark gray, abdomen dorsally brown, ventrally obscure yellow, dusted with gray. Male body length 9.0–12.0 mm, female 12.5–15.2 mm, male wing length 10.5–12.5 mm, female 9.7–14.5 mm.

Head: Dark gray, narrowly light gray along eye margin, sparsely covered with dark brown erect setae, longer ventrally, shorter dorsally. Vertex with low and wide, laterally dark brown tubercle. Eyes widely separated in both sexes, distance between them at base of antennae slightly less than length of scape. Antenna (Fig. 1A) 2.0–2.3 mm long in male, 2.2–2.5 mm in female, reaching to frontal margin of prescutum if bent backwards. Antennal scape long cylindrical, dark brown to blackish, sparsely dusted with gray and few semi-erect blackish setae. Pedicel dark brown, twice as short as scape. Basal flagellomere yellow at base, brownish distally, remainder of flagellum dark brown. Flagellomeres covered with short dense whitish pubescence, longest verticils nearly twice as long as respective segments. 2–4 flagellomeres slightly dilated ventrally. Apical segment slightly exceeds preceding segment in length. Rostrum blackish, sparsely dusted with gray. Palpus dark brown, dusted with gray, mouth parts blackish.

Thorax: Cervical sclerites dark brown to black, densely dusted with gray. Pronotum dark brown dusted with gray. Mesonotal prescutum lead-gray, laterally light gray, with four indistinct longitudinal stripes. Tubercular pits small but distinct, black, drop-shaped, pseudosutural fovea distinct, brown. Scutal lobe light gray because of dense pruinosity, darker frontally. Scutellum light gray. Mediotergite blackish frontally, light gray posteriorly. Dorsopleural membrane dark brown. Pleuron gray, sparsely variegated with darker areas where the bloom has been denuded, katapisternum setosless. Wing (Fig. 1B) slightly iridescent with brownish tinge and abundant small spots covering whole wing area; cross-veins surrounded by darker; larger spots at base of radial sector, at tip of *Sc*, at arculus and in the middle between arculus and base of *Rs*. Stigma yellowish with small dark spots at free end of *R*₁ and *R*₂. Veins brown, yellowish at wing base. Venation: *Sc* long, reaching wing margin slightly beyond branching point of *Rs*, *sc-r* beyond tip of *Sc*. *Rs* long, arched and sometimes short-spurred at base. Free end of *R*₁ very short, just slightly exceeds length of *R*₂. *R*₃ and *R*₄ slightly diverging towards wing margin, cell *r*₃ with short stem, which is

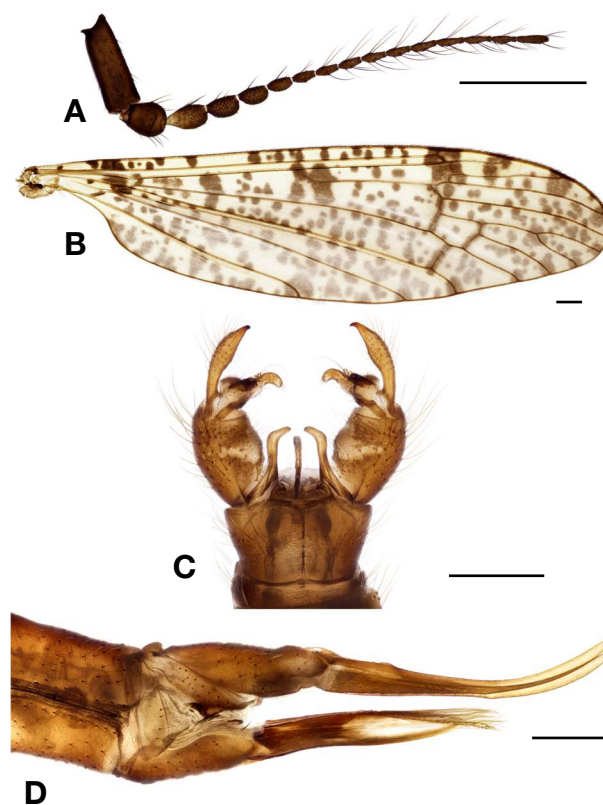


Fig. 1. *Limnophila (Limnophila) japonica* Alexander, 1913. A. antenna. B. wing. C. male genitalia, dorsal view. D. ovipositor, lateral view. Scale bars 0.5 mm.

approximately as long as free end of *R*₁. Cross-vein *r-m* distinct, at base of discal cell. Discal cell 1.6 times as long as wide. Cell *m*₁ long, slightly longer than stem. Cross-vein *m-cu* at middle length of discal cell. Anal vein long, slightly arched at wing margin, apex reaching wing margin at the level of *Rs* base. Anal angle long and narrow, widely rounded. Length of male halter 1.5–1.7 mm, female 1.5–1.9 mm, stem pale brown, reddish at base, knob blackened. Coxae reddish dark brown, dusted with gray and sparsely covered with long yellowish setae. Trochanters brownish yellow with blackened ventro-posterior margin, sparsely dusted with gray. Femur yellow with dark brown apical ring. Tibia brownish with narrowly dark brown apex. Tarsomeres dark brown with base of first tarsomere light brown. Tibia of foreleg with single apical spur, tibiae of middle and hind pairs of legs with two apical spurs each. Male femur I: 6.5–7.8 mm long, II: 7.3–7.5 mm, III: 8.2–8.5 mm, tibia I: 7.8–8.3 mm, II: 7.5–7.8 mm, III: 9.0–9.5 mm, tarsus I: 7.5–8.2 mm, II: 6.5–6.8 mm, III: 5.8–6.5 mm. Female femur I: 6.0–7.0 mm long, II: 6.7–7.0 mm, III: 7.8–8.5 mm, tibia I: 7.0–9.0 mm, II: 7.4–7.5 mm, III: 8.7–9.4 mm, tarsus I: 7.0–8.0 mm, II: 6.5–7.0 mm, III: 5.5–5.7 mm. Claw simple, spineless.

Abdomen: Abdominal tergites grayish brown, yellowish

laterally and at base, sparsely setose. Basal tergite gray. Tergites with two pairs of transverse sutures. Sternites grayish yellow, brownish laterally and posteriorly. Male terminalia (Fig. 1C) brownish yellow. Ninth tergite wider than longer, posterior margin with two medially curved lobes. Gonocoxite oval, simple, without additional lobes or spines. Outer gonostylus setose, spindle-shaped with slightly darkened and arched point-apexed tip. Inner gonostylus wide, fleshy and setose at base, distal part slightly extended and arched, blunt-apexed; small bump covered with long setae on dorsal surface. Paramere long rod-shaped, strongly curved medially. Aedeagus long, strongly arched, apex curved downwards. Ovipositor (Fig. 1D) very long and narrow, yellowish brown. Tenth tergite elongate, grayish-yellow, cercus very long and narrow, slightly arched towards distal end, darker at base, yellow at tip, round-apexed. Hypoalva long, straight and narrow, with long parallel setae distally along dorsal margin.

Elevation range in Korea. From sea level to 550 m.

Period of activity in Korea. Probably two generations a year, one lasts from late April through middle of June, some adults are also observed flying in late August.

Habitat. Mixed forest and shrubs covering slopes to the mountainous stream, spring margins.

General distribution. Japan and Russian Far East.

Examined material (Fig. 4A). 1 male (pinned), S. Korea, #3, 7 miles West of Chungju, 1954.04.27, coll. G.W. Byers (USNM); 2 males (pinned), S. Korea, #14, Oho-ri, east coast, alt. 10–50 ft. [3–15 m], 128°30'E, 38°20'N, 1954.06.11, coll. G.W. Byers (SMEC, USNM); 5 males (in ethanol), S. Korea, Jeollabuk-do, Namwon, Unbong-eup, Hwasu-ri, N35.45098, E127.57596, alt. 509 m, 2013.05.06 (1), coll. S. Podenas (NIBR); 2 males (in ethanol), S. Korea, Jeollabuk-do, Namwon, Sannae-myeon, Ipseok-ri, N35.41021, E127.64735, alt. 319 m, 2013.05.11 (1), coll. S. Podenas (NIBR); 1 male (pinned), S. Korea, Jeollanam-do, Gurye-gun, Toji-myeon, Naeseo-ri, Piagol Valley, N35.26590, E127.58096, alt. 446 m, 2014.08.24 (1), coll. S. Podenas (NIBR); 2 males, 1 female (in ethanol), S. Korea, Gyeongsangnam-do, Masanhappo-gu, Jindong-myeon, Dagu-ri, N35.11309, E128.53067, 2014.08.31 (2), coll. S. Podenas (NIBR); 1 male (in ethanol), S. Korea, Jeollanam-do, Gurye-gun, Toji-myeon, Naeseo-ri, Piagol Valley, N35.26590, E127.58096, alt. 446 m, 2015.04.28 (1), coll. S. Podenas (NIBR); 5 males (in ethanol), 1 female (pinned), S. Korea, Jeollanam-do, Gurye-gun, Toji-myeon, Naeseo-ri, Piagol valley, N35.25257, E127.58981, alt. 304 m, 2015.04.28 (2), coll. S. Podenas (NIBR); 2 males (in ethanol), S. Korea, Jeollanam-do, Gurye-gun, Toji-myeon, Naeseo-ri, Piagol Valley, N35.25257, E127.58981, alt. 304 m, 2015.04.29 (1), coll. S. Podenas (NIBR); 1 male (in ethanol), 1 male, 3 females (pinned), S. Korea, Jeollanam-do, Gurye-gun, Toji-myeon, Naeseo-ri, Piagol Valley, N35.27177, E127.57146, alt. 490 m,

2015.05.02 (1), coll. S. Podenas (NIBR); 2 females (in ethanol), S. Korea, Jeollanam-do, Gurye-gun, Toji-myeon, Naeseo-ri, Piagol Valley, N35.25825, E127.58208, alt. 310 m, 2015.05.02 (2), S. Podenas (NIBR); 4 males, 2 females (in ethanol), 1 male (pinned), S. Korea, Jeollanam-do, Gurye-gun, Toji-myeon, Naeseo-ri, Piagol Valley, N35.25257, E127.58981, alt. 304 m, 2015.05.02 (3), coll. S. Podenas (NIBR); 2 males, 1 female (in ethanol), S. Korea, Jeollanam-do, Gurye-gun, Toji-myeon, Naeseo-ri, Piagol Valley, N35.27333, E127.56924, alt. 546 m, 2016.06.03 (3), S. Podenas (NIBR); 1 female (in ethanol), S. Korea, Jeollanam-do, Gurye-gun, Toji-myeon, Naeseo-ri, Piagol Valley, N35.26586, E127.58090, alt. 448 m, 2016.06.03 (4), coll. S. Podenas (NIBR); 2 males, 2 females (pinned), S. Korea, Jeollanam-do, Gurye-gun, Toji-myeon, Naeseo-ri, Piagol Valley, N35.27333, E127.56924, alt. 546 m, 2016.06.04 (3), S. Podenas (NIBR); 5 males (in ethanol), 3 males (pinned), S. Korea, Gyeonggi-do, Gunpo-si, Suridong, N37.35022, E126.91527, alt. 138 m, 2017.05.27 (1), S. Podenas (NIBR). Also compared with: metatype, 1 male (antenna, wing, leg and genitalia slide mounted), Japan, Shikoku, Ojoin-mura, Iyo, IV-14-1949, M. Miyatake (USNM).

***Limnophila (Limnophila) pictipennis* (Meigen, 1818)**

Limnobia pictipennis Meigen, 1818: 119, 120.

Limnophila angustipennis Meigen, 1818: 120.

Poecilostola pictipennis Schiner, 1864: 552; Meijere, 1921: 62; Pierre, 1924: 120; Nielsen, 1925: 71; Cziżek, 1931: 127, 129.

Poecilostola angustipennis Schiner, 1864: 552; Meijere, 1921: 62; Pierre 1924: 120; Nielsen, 1925: 71; Cziżek, 1931: 130.

Limnophila pictipennis Macquart, 1834: 95; Edwards, 1938: 85; Coe, 1950: 42; Savchenko, 1986: 272, 273.

Limnophila (Limnophila) pictipennis Savchenko, 1983: 54; 1989: 92.

General. Body coloration dark brown densely dusted with gray. Male body length 9.7–12.0 mm, female 12.8–14.7 mm, male wing length 11.5–12.5 mm, female 11.5–13.5 mm.

Head (Fig. 2C): Gray, light gray along eye margin, brown dorsally, narrowly reddish-brown at base, sparsely covered with dark brown erect setae. Vertex with low wide tubercle marked with median dark line. Eyes widely separated in both sexes, distance between them at base of antenna approximately equals to length of scape. Antenna (Fig. 2A) 1.9–2.0 mm long in male, 2.1–2.2 mm in female, reaching slightly beyond frontal margin of prescutum if bent backwards. Antennal scape long cylindrical, dark brown, three times as long as succeeding segment, densely dusted with brownish gray and bearing few short semi-erect brown setae. Pedicel dark brown, dusted with gray,

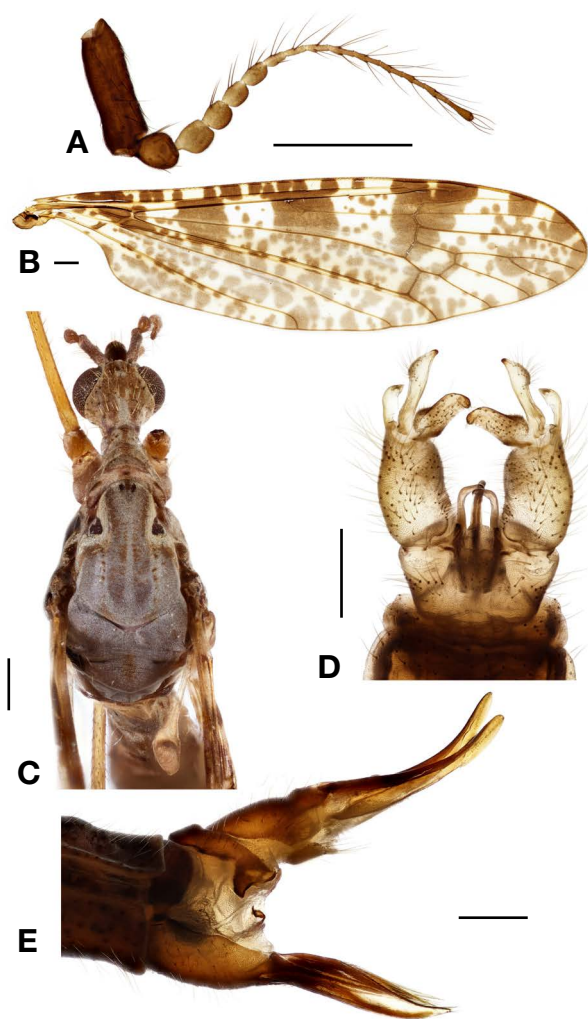


Fig. 2. *Limnophila (Limnophila) pictipennis* Meigen, 1818. A. antenna. B. wing. C. thorax and head, dorsal view. D. male genitalia, dorsal view. E. ovipositor, lateral view. Scale bars 0.5 mm.

widened distally. Four basal flagellomeres brown, yellowish at base, strongly dilated ventrally. Remaining flagellomeres elongate, brown to dark brown. All flagellomeres at basal half of flagellum covered with dense whitish pubescence. Verticils dark brown, longest three times as long as respective segments. Apical segment approximately as long as preceding segment. Rostrum dark brown, densely covered with brownish gray pruinosity, few long setae dorso-apically and ventrally. Palpus brown, mouth-parts brown.

Thorax: Cervical sclerites dark brown laterally and ventrally, light brown dorsally at base of head, densely dusted with gray. Pronotum large, gray with brown median line and less distinct lateral longitudinal spot. Mesonotal prescutum gray with four indistinct darker brown longitudinal stripes (Fig. 2C). Median stripes usually separated by narrow gray line. Tubercular pits small but distinct, at frontal

margin of sclerite, pseudosutural fovea distinct, brown, indistinct transverse brown spot beyond fovea. Scutal lobe light gray with two indistinct brownish spots. Area between scutal spots light gray. Scutellum light gray with dark brown median line. Mediotergite light gray, brownish posteriorly. Dorsopleural membrane brown, dusted with gray. Pleuron light gray, sparsely variegated with darker areas where the bloom has been denuded, katapisternum bare, setosless. Wing (Fig. 2B) iridescent with brownish tinge and abundant spots covering whole wing area: four large spots at frontal margin, at arculus, at middle between arculus and base of *Rs*, at both ends of radial sector; cross-veins and distal parts of all longitudinal veins surrounded by darker; remainder of wing surface and along veins with abundant small spots. Stigma dark brown with small yellowish spot at middle. Veins brown, yellowish at wing base. Venation: *Sc* long, nearly reaching branching point of *Rs*, *sc-r* beyond tip of *Sc*, at branching point of radial sector. *Rs* long, arched and sometimes short-spurred at base. Free end of *R*₁ twice as long as *R*₂. *R*₃ and *R*₄ slightly diverging towards wing margin, cell *r*₃ with very short stem or making point-contact with base of *R*₅. Cross-vein *r-m* distinct, at base of discal cell. Discal cell 1.8 times as long as wide. Cell *m*₁ long, stem slightly shorter than cell itself. Cross-vein *m-cu* at middle length of discal cell. Anal vein long, distinctly arched at wing margin, apex at the level of *Rs* base or slightly beyond. Anal angle long and narrow, widely rounded. Length of male halter 1.5–1.9 mm, that of female 1.9–2.0 mm, stem brown, dusted with gray, with row of erect long setae before middle, knob dark brown, grayish pruinose. Coxae brown, dusted with gray bearing few long rusty-brown setae apically. Trochanters brownish yellow marked with black ventrally, sparsely dusted with gray. Femur and tibia yellow with dark brown apical ring. Basal tarsomere brown with yellowish base and dark brown apex, remaining tarsomeres dark brown. Tibia of foreleg with single apical spur, tibiae of middle and hind pairs of legs with two apical spurs each. Male femur I: 6.5–7.5 mm long, II: 7.5–7.6 mm, III: 7.8–8.5 mm, tibia I: 8.0–8.8 mm, II: 8.8–9.0 mm, III: 8.5–10.0 mm, tarsus I: 7.7–8.8 mm, II: 7.1–7.3 mm, III: 6.1–6.7 mm. Female femur I: 6.0–7.7 mm long, II: 6.0–7.5 mm, III: 7.0–8.5 mm, tibia I: 6.0–8.1 mm, II: 6.5–8.0 mm, III: 9.3–10.0 mm, tarsus I: 7.5–7.6 mm, II: 5.2–6.5 mm, III: 5.6–6.5 mm. Claw simple, spineless, dark brown.

Abdomen: Abdominal tergites grayish brown, narrowly grayish-light brown laterally, sparsely setose. Basal tergite gray, second and third tergites yellowish. Tergal sclerite with pair of transverse sutures. Sternites bluish-grayish brown, yellowish before middle of abdomen. Male terminalia (Fig. 2D) brownish-yellow to rusty-brownish-yellow depending on specimen. Ninth tergite distinctly wider than longer, posterior margin slightly extended medially. Gonocoxite slightly elongate, with distinct fleshy knob-

shaped apical lobe at base of outer gonostylus. Outer gonostylus setose, narrow at basal half, dilated distally, apex rounded and slightly darkened. Inner gonostylus wide, fleshy and setose, narrowing towards apex, distal part slightly extended and arched, blunt-apexed. Paramere long rod-shaped, strongly curved medially. Aedeagus long, strongly arched, apex curved downwards. Ovipositor (Fig. 2E) brownish yellow. Tenth tergite elongate, yellow with darkened distal part, cercus long and arched, darker at base, yellow at tip, round-apexed. Hypoalva long and straight.

Elevation range in Korea. From 900 to slightly above 1,500 m.

Period of activity in Korea. From early June through middle of July.

Habitat. Muddy margins of springs and small streams covered with shrubs and dense grassy vegetation.

General distribution. East and West Palearctic.

Examined material (Fig. 4B). 4 males, 2 females (pinned), North Korea, Chonsani Paiktusan, alt. 3,200 ft. [975 m], 1937.07.12, A. Yankovsky (USNM); 2 males, 2 females (pinned), North Korea, Chonsani Paiktusan, alt. 3,400 ft. [1,036 m], 1937.07.15, A. Yankovsky (USNM); 1 male (pinned), North Korea, Chonsani, alt. 5,000 ft. [1,524 m], 1940.06.02, A. Yankovsky (USNM); 2 males (pinned), North Korea, Chonsani, alt. 3,000 ft. [914 m], 1940.06.22, A. Yankovsky (USNM). Also compared with: 1 male, 1 female (pinned) Lithuania, Jurbarkas, N55.08077, E22.75132, alt. 18 m, 1989.05.09, S. Podenas (VU); 1 female (in ethanol), Lithuania, Birzai distr., Gojelis, N56.21197, E24.68720, alt. 58 m, 1993.08.16, S. Podenas (VU); 1 male (pinned), Lithuania, Kaisiadorys, Girele forest, N54.85037, E24.42522, alt. 96 m, 1994.08.23, V. Dobrovolskyte (VU); 1 male (in ethanol), Lithuania, Vilnius distr., Suderve, N54.78667, E25.08630, alt. 174 m, 1995.06.11, S. Podenas (VU).

***Limnophila (Limnophila) politostriata* Alexander, 1934**

Limnophila (Limnophila) politostriata Alexander, 1934a: 338, 339; Savchenko, Krivolutskaya, 1976: 64; Savchenko, 1989: 93.

General. Body coloration bluish gray. Male body length 10.0–11.4 mm, female 12.0–13.7 mm, male wing length 10.5–11.2 mm, that of female 11.5–12.0 mm.

Head (Fig. 3B): Silvery-gray frontally, lead-gray posteriorly, narrowly brownish laterally at base, sparsely covered with short dark brown erect setae. Vertex with low wide tubercle spotted with dark brown at middle. Eyes widely separated in both sexes, distance between them at base of antennae approximately equals length of scape. Antenna 2.0 mm long in male, 1.7–2.1 mm in female, reaching to about middle of pronotum if bent backwards. Antennal scape long nearly cylindrical dark brown, sparsely dusted

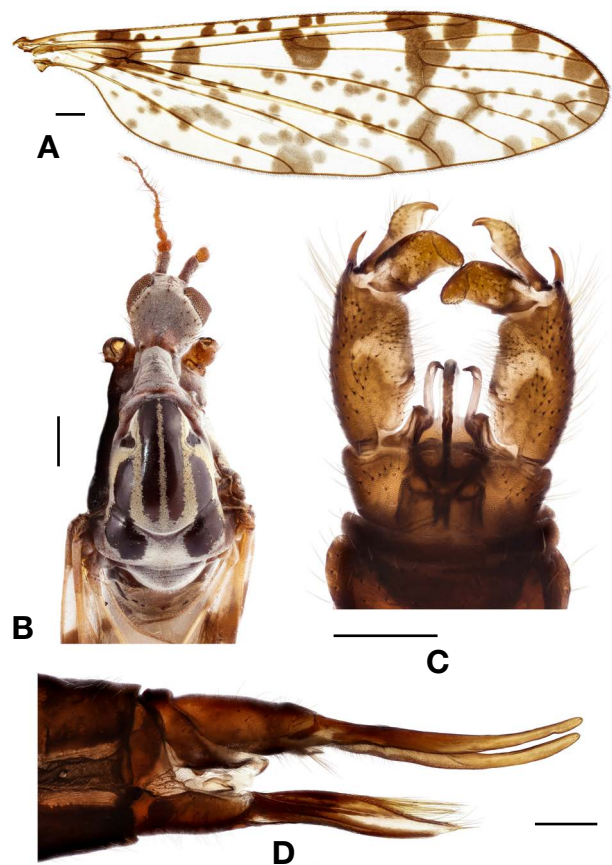


Fig. 3. *Limnophila (Limnophila) politostriata* Alexander, 1934. A. wing. B. thorax and head, dorsal view. C. male genitalia, dorsal view. D. ovipositor, lateral view. Scale bars 0.5 mm.

with brownish gray and bearing few short brown raised setae. Pedicel twice as short as scape, yellowish brown, widened distally. Flagellum yellowish brown to light brown, covered with short dense grayish pubescence, four basal flagellomeres dilated ventrally. Remaining flagellomeres elongate. Verticils dark brown, longest three times as long as respective segments. Apical segment large, approximately as long as preceding segment. Rostrum dark brown, densely covered with brownish gray pruinosity, few long setae at apex. Basal palpomere blackish, remainder of palpus and mouth parts dark brown.

Thorax: Cervical sclerites dark brown, covered with light gray pruinosity that is especially dense ventrally. Pronotum large, light gray because of dense pruinosity, with brownish postero-lateral angle. Mesonotal prescutum (Fig. 3B) brownish gray with four very distinct polished black longitudinal stripes. Median stripes reaching each other only at frontal margin of sclerite, remainder separated by narrow gray line. Tubercular pit black but hardly distinguishable because it is merged with median stripe, pseudosutural fovea distinct with polished dark brown central part and black posterior margin. Scutal lobe light

gray with large polished black central area which makes an extension of lateral prescutal stripe. Area between scutal lobes light gray to dark gray depending on specimen. Central area of scutellum light gray, frontal margin blackish, posterior brownish. Mediotergite light gray with polished dark brown posterior margin. Dorsopleural membrane yellowish brown, dusted with gray. Pleuron light gray, katapisternum setoseless, ventrally dark brown because of sparser pruinosity. Wing (Fig. 3A) iridescent in male but not in female, with abundant spots and large white areas: largest spots at arculus and at both ends of radial sector; cross-veins and distal parts of all longitudinal veins surrounded by darker; largest white areas separate largest dark spots, remainder of wing surface and along veins with abundant small spots. Stigma hidden by dark spot. Veins brown, yellowish at wing base. Venation: *Sc* long, nearly reaching branching point of *Rs*, *sc-r* beyond tip of *Sc*, at branching point of radial sector. *Rs* long, arched at base. Free end of *R*₁ 1.5 times as long as *R*₂. *R*₂ indistinct. *R*₃ and *R*₄ diverging towards wing margin, cell *r*₃ with very short stem. Cross-vein *r-m* long and distinct, at base of discal cell. Discal cell twice as long as wide. Cell *m*₁ short, stem more than twice as long as cell itself. Cross-vein *m-cu* slightly before middle of discal cell. Anal vein long, slightly sinuous, apex reaching wing margin at the level of *Rs* base. Anal angle long and narrow, widely rounded. Length of male halter 1.6–1.9 mm, that of female 1.9–2.0 mm, stem brownish yellow with darker base, knob dark brown. Coxae brown, densely dusted with light gray. Trochanters brown, sparsely dusted with gray. Femur yellow with distinctly dark brown distal part. Tibia yellow with narrowly darkened apex. Tarsus dark brown with light

brown base of basal tarsomere. Tibia of foreleg with single apical spur, tibiae of middle and hind pairs of legs with two apical spurs each. Male femur I: 5.8–6.6 mm long, II: 6.5–8.0 mm, III: 7.0 mm, tibia I: 7.2–7.3 mm, II: 7.3–9.0 mm, III: 7.7 mm, tarsus I: 8.5 mm, III: 5.7 mm. Female femur I: 5.2–6.5 mm long, II: 6.2–7.0 mm, III: 7.0–7.5 mm, tibia I: 6.3–6.7 mm, II: 6.2–6.3 mm, III: 7.7–8.0 mm, tarsus I: 5.2–6.5 mm, II: 5.4–5.5 mm, III: 5.2–5.4 mm. Claw simple, without spines or teeth, dark brown.

Abdomen: Abdominal tergites sparsely setose, light gray with brown posterior margin. Tergite with pair of semi-polished transverse sutures and similar narrow oblique stripes that turn shorter on posterior tergites. Sternites brown, yellowish at base of abdomen, densely covered with gray pruinosity. Male terminalia (Fig. 3C) brown, yellowish at base, blackish at apex. Ninth tergite distinctly wider than longer, posterior margin widely rounded, slightly raised medially. Gonocoxite elongate, nearly cylindrical, with distinct apical spine at base of outer gonostylus. Outer gonostylus setose, narrow at basal half, dilated distally, apex blunt and slightly darkened. Inner gonostylus wide, fleshy and setose, nearly parallel-sided, distal part raised upwards. Paramere long rod-shaped, with narrower distal part, strongly curved ventrally. Aedeagus long, tube-shaped, strongly arched, apex curved downwards. Tenth tergite of female abdomen (Fig. 3D) elongate, narrow, brown and covered with gray pruinosity. Ovipositor with cercus and hypovalva polished reddish brown, cercus long and arched, darker at base, yellow at tip, round-apexed. Hypovalva long and straight.

Elevation range in Korea. From 850 to nearly 1,200 m.

Period of activity in Korea. From middle of June through

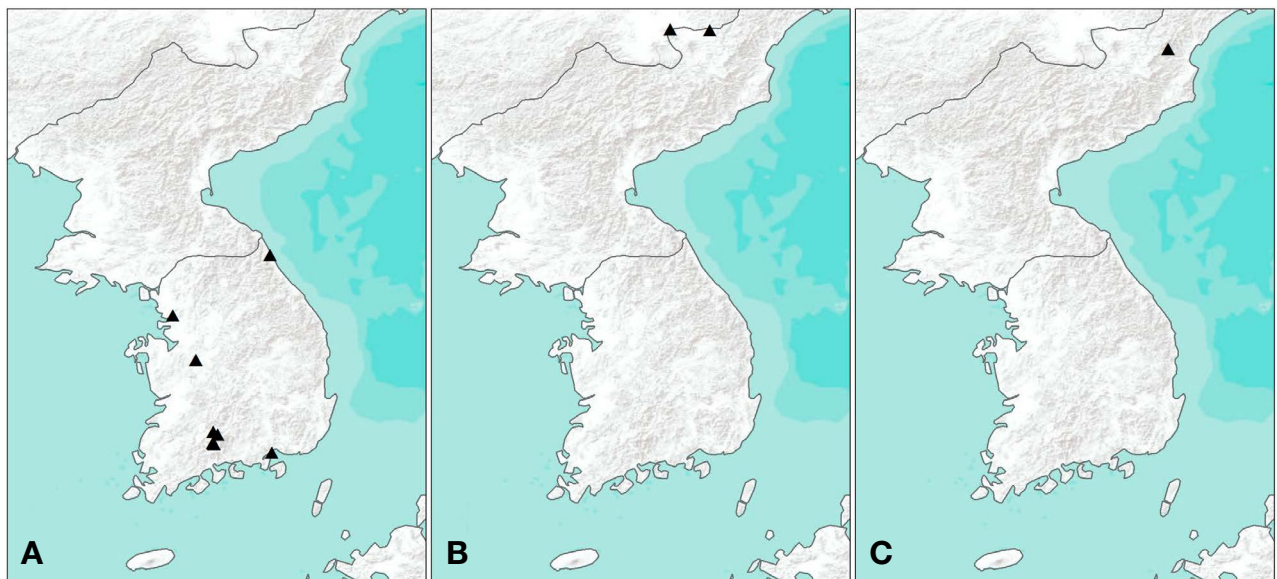


Fig. 4. Distribution maps of Korean *Limnophila* (*Limnophila*) crane flies. A. *L. (L.) japonica*. B. *L. (L.) pictipennis*. C. *L. (L.) politostriata*.

early July.

Habitat. Muddy margins of springs and small streams covered with shrubs and dense grassy vegetation.

General distribution. Russian Far East.

Examined material (Fig. 4C). metatype, 1 male (antenna, both hind legs and genitalia slide mounted), North Korea, Seren. Mts., alt. 3,800 ft. [1,158 m], 1938.06.14, A. Yankovsky (USNM); 1 male, 2 females (pinned), North Korea, Seren Mts., alt. 2,800 ft. [853 m], 1938.06.22, A. Yankovsky (USNM); 2 males, 2 females (pinned), North Korea, Seren Mts., alt. 3,000 ft. [914 m], 1938.06.25, A. Yankovsky (USNM); 1 male (pinned), North Korea, Seren Mts., alt. 3,000 ft. [914 m], 1938.07.02–03, A. Yankovsky (USNM); 1 male, 1 female (pinned), North Korea, Seren Mts., alt. 3,700 ft. [1,128 m], 1938.07.05, A. Yankovsky (USNM). Also compared with: holotype, male (antenna, fore leg, gonocoxite with gonostyli slide mounted), [Russia], E. Siberia, Ussuri [mouth of river Amur] Osernaja, June 24, 1915, W. Chernawin (USNM).

ACKNOWLEDGEMENTS

Our warmest thanks to all Korean friends and colleagues who helped us during our visits to South Korea and all those who helped to collect crane flies. We are very grateful for J. C. Thomas for the help with Korean specimens from the University of Kansas, U. S. A.; Dr. F. Shockley and Dr. T. Dikow (USNM), Dr J. K. Gelhaus (Academy of Natural Sciences of Drexel University, U. S. A.) for the possibility to use specimens from the USNM collections. Special thanks are extended to Dr M. Dagens for his help to prepare distribution maps.

This work was supported by a grant from the National Institute of Biological Resources (NIBR), funded by the Ministry of Environment (MOE) of the Republic of Korea (NIBR202102111).

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Submitted: October 29, 2021

Revised: March 11, 2022

Accepted: March 12, 2022