

Redescriptions of Two Northeast Asian Sawfly Species, *Arge solowiyofka* and *A. kobayashii* (Hymenoptera, Argidae), Associated with *Betula*

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Abstract Two Northeast Asian sawfly species associated with *Betula*, *Arge solowiyofka* (Matsumura, 1911) and *A. kobayashii* Takeuchi, 1931 (Hymenoptera, Argidae), are redescribed based on a long series of specimens including the type material. The immature stages and life history of *A. kobayashii* are described for the first time. Additional information on the distribution of these two species and the immature stages and host plant of *A. solowiyofka* is given.

Key words: Hymenoptera, Argidae, *Arge solowiyofka*, *Arge kobayashii*, new distribution record, new host plant record.

Arge solowiyofka (Matsumura, 1911) and *A. kobayashii* Takeuchi, 1931 are blue-black sawfly species having hyaline wings with a distinct black mark below the stigma, a black antenna, a basally pale hind tibia and white setae on the mesopleuron. We often referred to these two Northeast Asian species in our papers on Japanese *Arge* (Hara and Shinohara, 2012a, b, 2014a, b; Hara *et al.*, 2012; Shinohara and Hara, 2008, 2013), but we have not discussed them in detail until now. In this paper we redescribe *A. solowiyofka* and *A. kobayashii* based on a long series of specimens including the type material, give figures of their ovipositors and male genitalia, and provide information on their immature stages, distribution, life history and host plants.

Arge kobayashii belongs to a group of closely similar species including *A. expansa* (Klug, 1834), *A. fuscipes* (Fallén, 1808) and *A. ustulata* (Linné, 1758). Although we here treat *A. kobayashii* as a distinct species, the relationships among the taxa in this group have not been clarified with sufficient credibility (see Gussakovskij,

1935; Takeuchi, 1939, 1955; Zhelochovtsev, 1939; Benson, 1945, 1951, 1962; Verzhutskii, 1966; Lindqvist, 1973; Muche, 1977; Zhelochovtsev and Zinovjev, 1988; Smith, 1989; Viitasaari, 1990; Blank and Taeger, 1998; Liston *et al.*, 2010). We need a comprehensive study based on more information about immature stages, host preference, and molecular data of the relevant taxa to obtain a better picture of taxa in this species group.

Material and Methods

Specimens examined in this study are deposited in the National Museum of Nature and Science, Tsukuba, unless otherwise indicated. Abbreviations for other depositories are: EU = Ehime University, Matsuyama; HSC = H. Suda Collection, Sakura; HU = Hokkaido University, Sapporo; KU = Kobe University, Kobe; MNHAH = Museum of Nature and Human Activities, Hyogo, Sanda; OMNH = Osaka Museum of Natural History, Osaka; OPU = Osaka Prefecture

University, Sakai.

Observations of morphology were made with a Leica MS5 stereo binocular microscope and an Olympus BH light microscope. Measurements of each structure were taken with an ocular micrometer. Photographs were taken with digital cameras, Canon EOS Kiss Digital X, Nikon E990, Panasonic DMC-FZ730 and SONY DSC-RX100, Keyence Digital Microscope VHX-900, and AnMo Electronics Dinolite digital microscope mounted to BH light microscope. The digital images were processed and arranged with Adobe Photoshop Elements 7.0® software.

Rearings were done in Bibai by Hara and in Tokyo by Shinohara. In the rearing room in Bibai, the temperature and light there were almost the same as in open-air conditions, but the hibernating individuals were moved in March or April into an air-conditioned room, where the temperature was about 10–25°C. In the rearing room in Tokyo, the temperature was usually 18–25°C and the light was usually on for about 16 hours a day.

For morphological terminology, we followed Viitasaari (2002).

Results and Discussion

Arge solowiyofka (Matsumura, 1911)

Japanese name: Kuro-unmon-churenji

(Figs. 1A–D, 2A–F, 3A–E, 4, 6A–D)

Hylotoma solowiyofkum Matsumura, 1911: 87.

Arge solowiyofkum: Takeuchi, 1919: 188; Sundukov, 2009: 215.

Arge jonasi: Takeuchi, 1932: 37 [part]; Takeuchi, 1934: 24; Takeuchi, 1936: 63; Gussakovskij, 1935: 284, 426 [part]; Takeuchi, 1939: 408 [part]; Togashi, 1998a: 253; Togashi, 1998b: 39 [part]; Naito *et al.*, 2004: 11 [part]; Lelej and Taeger, 2007: 943. [Not Kirby, 1882.]

Arge abelivora: Naito *et al.*, 2004: 10 [part]. [Not Okutani, 1956.]

Arge solowiyofka: Hara *et al.*, 2007: 85; Shinohara and Hara, 2008: 43; Sundukov and Lelej, 2009: 7; Taeger *et al.*, 2010: 139; Yoshida, 2010: 22; Hara and Shinohara, 2012a: 31; Hara and Shinohara, 2012b: 85; Lelej, 2012: 64; Shinohara and Hara, 2013: 36; Hara and Shinohara, 2014a: 84, 94–96; Hara and Shinohara, 2014b: 296, 298.

Redescription. Female and male. Length 7.5–12.0 mm in female (Fig. 1A, B), 7.0–9.5 mm in male (Fig. 1C, D). Head and body black with reflection inconspicuous, blue green to blue metallic generally and purple metallic on basal abdominal terga. Antenna black, without metallic reflection; flagellum sometimes dark brown. In legs, coxae to femora black with inconspicuous blue metallic reflection; apex of fore femur yellow; narrow apices of middle and hind femora brownish; tibiae yellowish white; apex of middle tibia darkened or not darkened; hind tibia brown to black on apical fourth to third, but often narrowly orange at apical end, rarely entirely yellowish white to yellow; fore tarsus yellowish white, apically darkened; middle and hind tarsi brown to black, very often basally pale; tibial spurs yellow to brown. Wings hyaline, slightly yellowish on forewing basal to stigma, slightly yellow brownish or brownish on other areas, with black band below stigma extending to posterior margin of forewing; this band becoming inconspicuous in cell M and not covering apical area of cell M, but rarely disappearing in cell M; cells C and Sc distinctly yellowish; stigma dark brown to black, narrowly yellow to brown on base and apex (very rarely yellow on apical third to half); veins brown to black, in forewing yellow on C, Sc, most or part of section of R1 basal to stigma and apical section of R1, and often also on A. Setae mostly whitish; those on mesonotum mostly brownish.

Head in dorsal view swollen behind eyes in female (Fig. 2A), slightly so in male. Median ocellus distinctly raised; glabrous area around median ocellus wide (Fig. 2B, E). Frontal area anterolaterally distinctly convex (nearly flat in only one reared female). Frontal pit small and shallow or somewhat deep. Interantennal carinae dorsally curved medially and narrowly separated from each other (Fig. 2B, E) (widely separated from each other in only one reared female), ventrally converging to each other and becoming low or inconspicuous (Fig. 2C, D, F), blunt throughout in female, sharp and dorsally and ventrally blunt in male. Supraclypeal area with

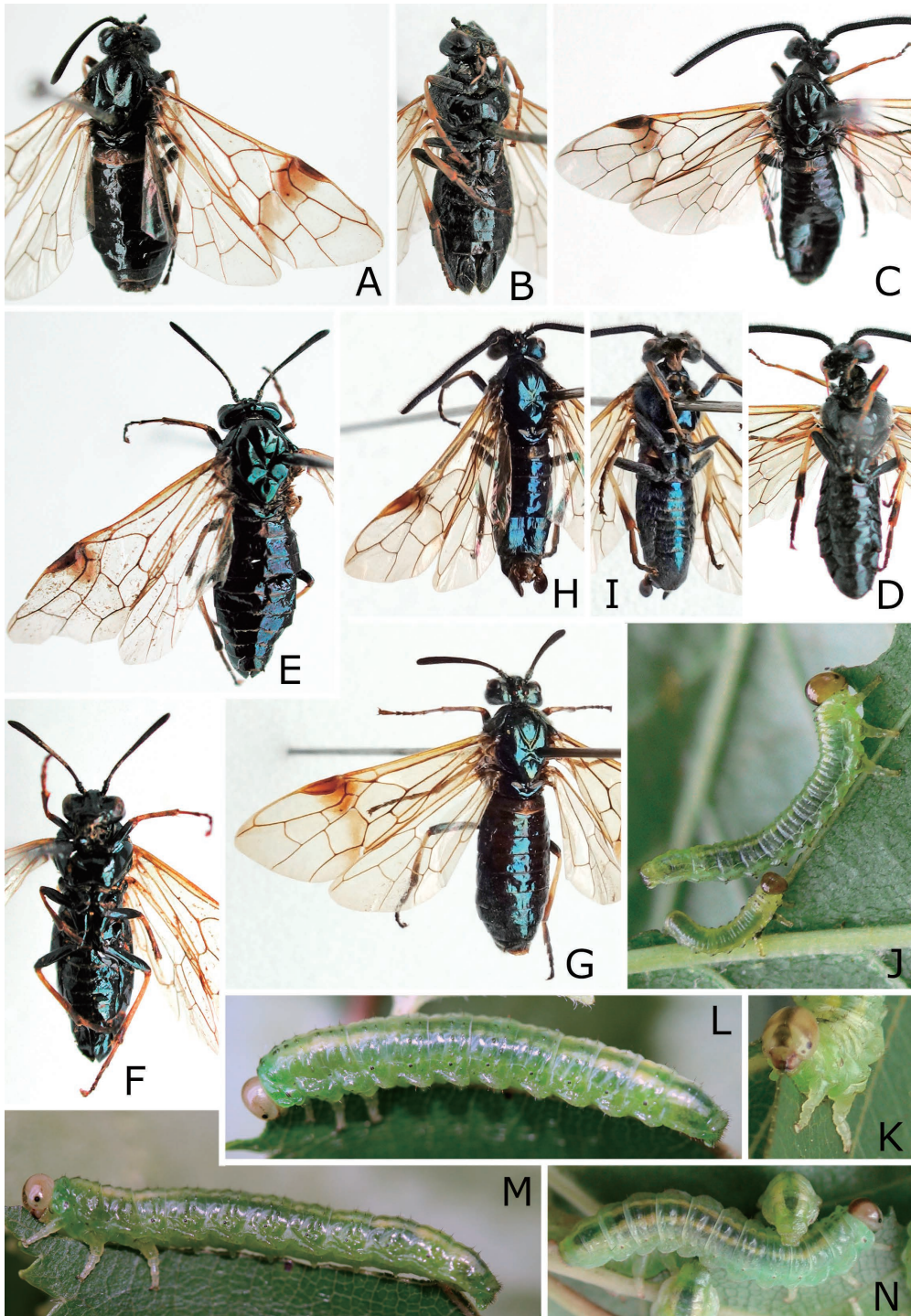


Fig. 1. A–D, *Arge solowiyofka*: A, B, Holotype, female; C, D, male, Kamishihoro. E–N, *Arge kobayashii*: E, F, Holotype, female; G, female, Kamikochi; H, I, male, Kimobetsu; J, middle and semifinal instar larvae, offspring of HH070619A; K–N, final instar larvae (K, offspring of HH070619A; L, M, AS070806B; N, offspring of HH040623A). A, C, E, G, H, Dorsal or dorsolateral view; B, D, F, I, ventral or ventrolateral view. J, K, N, photographed by Hara, L, M, by Shinohara.

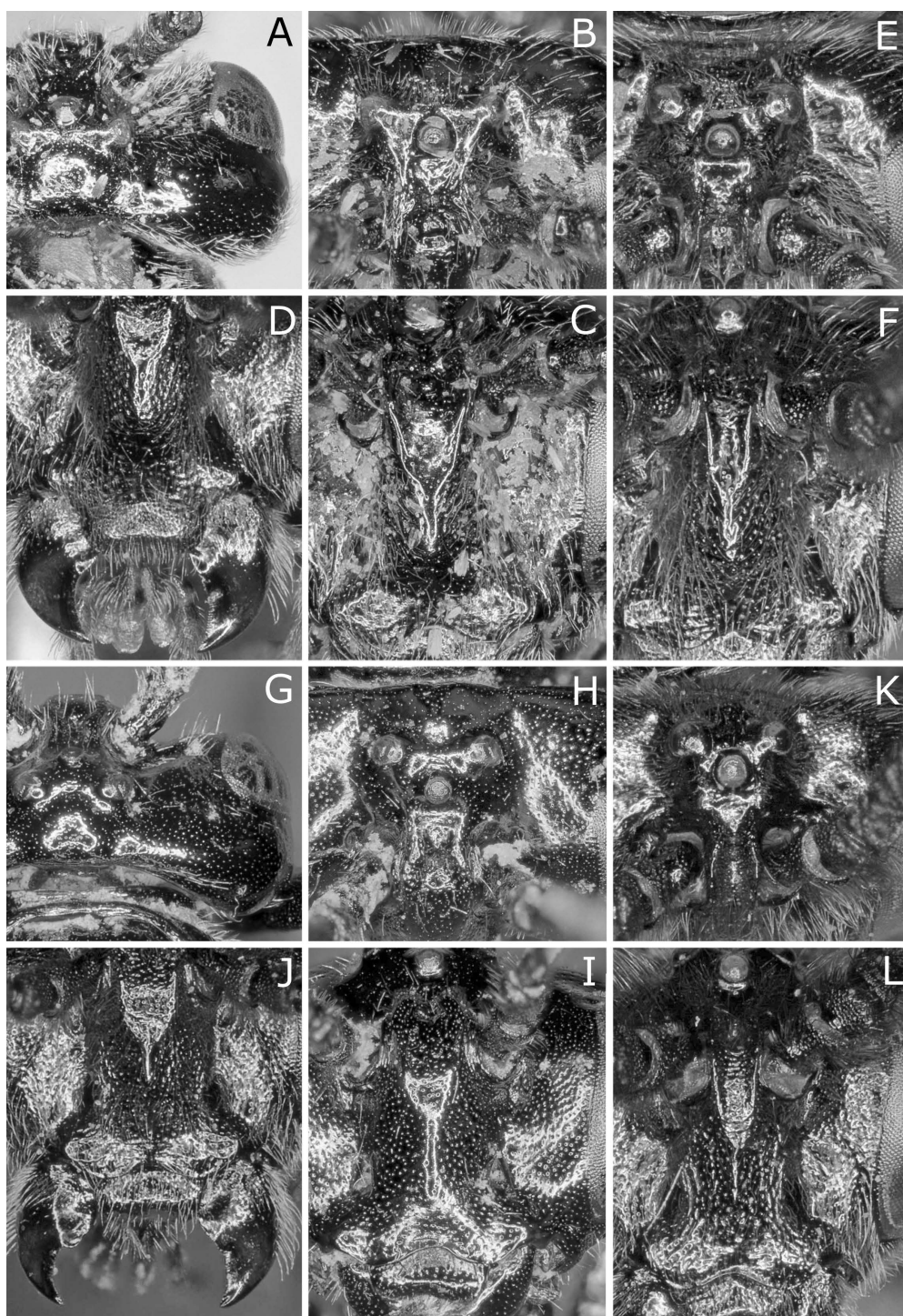


Fig. 2. A, G. Head, dorsal view; B, E, H, K, dorsomedial part of head, anterodorsal view; C, D, F, I, J, L, ventromedial part of head, anterior view. A–F, *Arge solowiyofka*: A–C, Holotype, female; D, female, Hidaka; E, F, male, Chino. G–L, *Arge kobayashii*: G–I, Holotype, female; J, female, Hidaka; K, L, male, Kimobetsu.

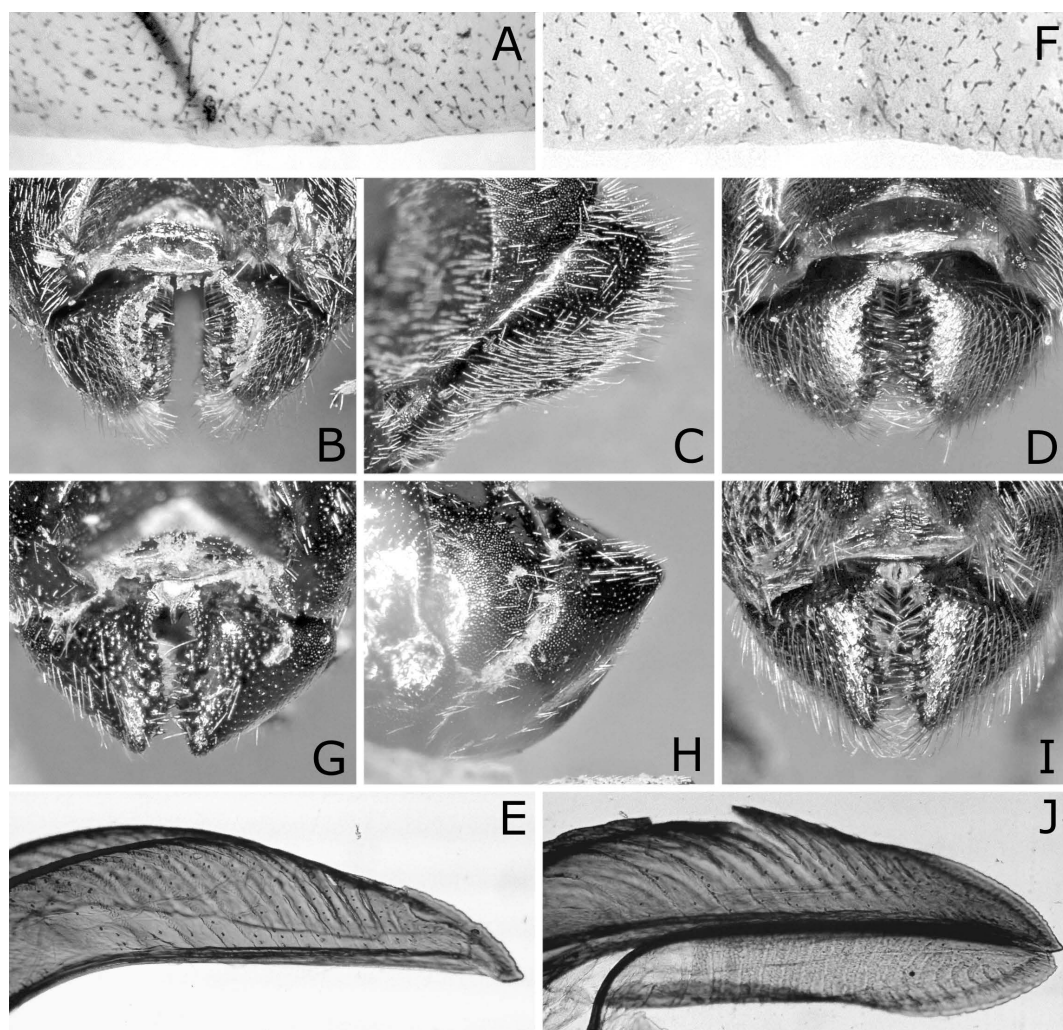


Fig. 3. A, F, Apical margin of forewing around apex of vein M; B, D, G, I, ovipositor sheath, posterodorsal view; C, H, do., lateral view; E, J, lance, lateral view. A–E, *Arge solowiyofka*: A–C, E, Holotype, female; D, female, Kimobetsu. F–J, *Arge kobayashii*: F–H, J, Holotype, female; I, female, Shikaoi.

median ridge rounded, often bluntly carinate in both sexes, rarely sharply carinate in male, and side slope weakly rounded or nearly flat (Fig. 2C, F). Clypeus not widely flattened. Antenna normal; in male, length $2.2\text{--}2.7 \times$ head width. Right mandible without notch on inner margin (Fig. 2D). In forewing, cell 1Rs2 with anterior length $0.9\text{--}1.2 \times$ posterior length; crossvein 3r-m roundly or somewhat angularly curved (Fig. 1A, C). In both wings, margin between veins Rs and Cu glabrous, with marginal glabrous area wider than width of vein M and marginal setae shorter than

width of vein M (Fig. 3A). Dorsum of abdomen smooth and almost glabrous on second to fifth terga (except for narrow lateral areas) and glabrous or sparsely setose on medial area of six tergum in female; smooth and almost glabrous on second to fourth terga and with very sparse minute setae on fifth to seventh terga in male.

In female, seventh sternum normal. Ovipositor sheath (Fig. 3B–D) in posterodorsal view wider than long, with lateral margin gently rounded and apex narrowly or moderately rounded. Lance with several very narrow membranous areas

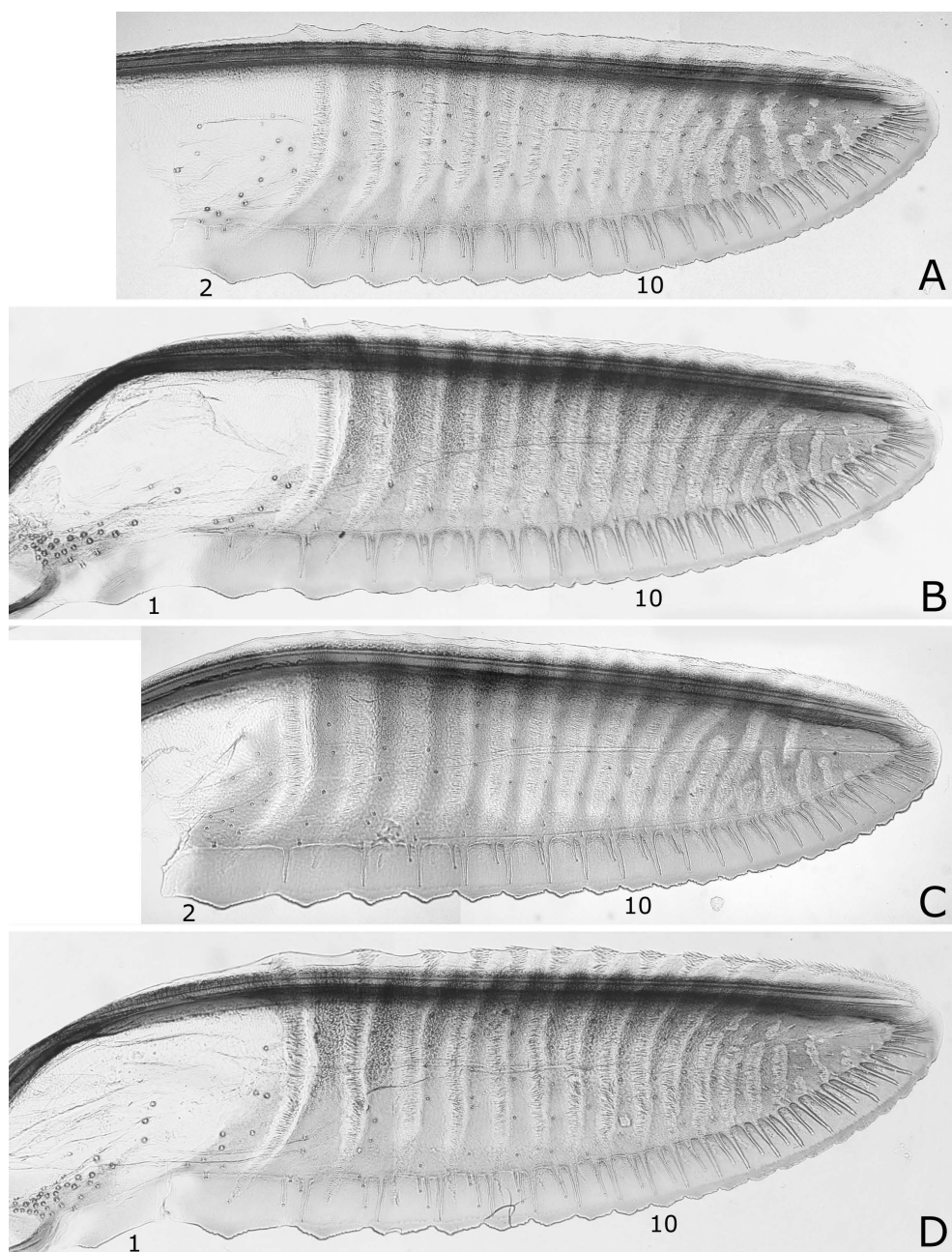


Fig. 4. Lancet of *Arge solowiyofka*: A, Holotype (reversed); B, Mt. Oginosen; C, Mt. Ishizuchi-yama (reversed); D, Mt. Taradake. Numerals 1, 2, 10, First (most basal), second and tenth serrulae.

midapically (Fig. 3E). Lancet (Fig. 4) with about 23–25 serrulae, without row of setae (= ctenidium) before first annulus, dorsoapically with narrow nonannulated area; middle annuli nearly straight or slightly sinuate; apical annuli slightly

arched; basal and middle serrulae triangular, each with anterior slope much shorter than posterior slope; apical serrulae weakly but distinctly convex.

In male, subgenital plate apically narrowly

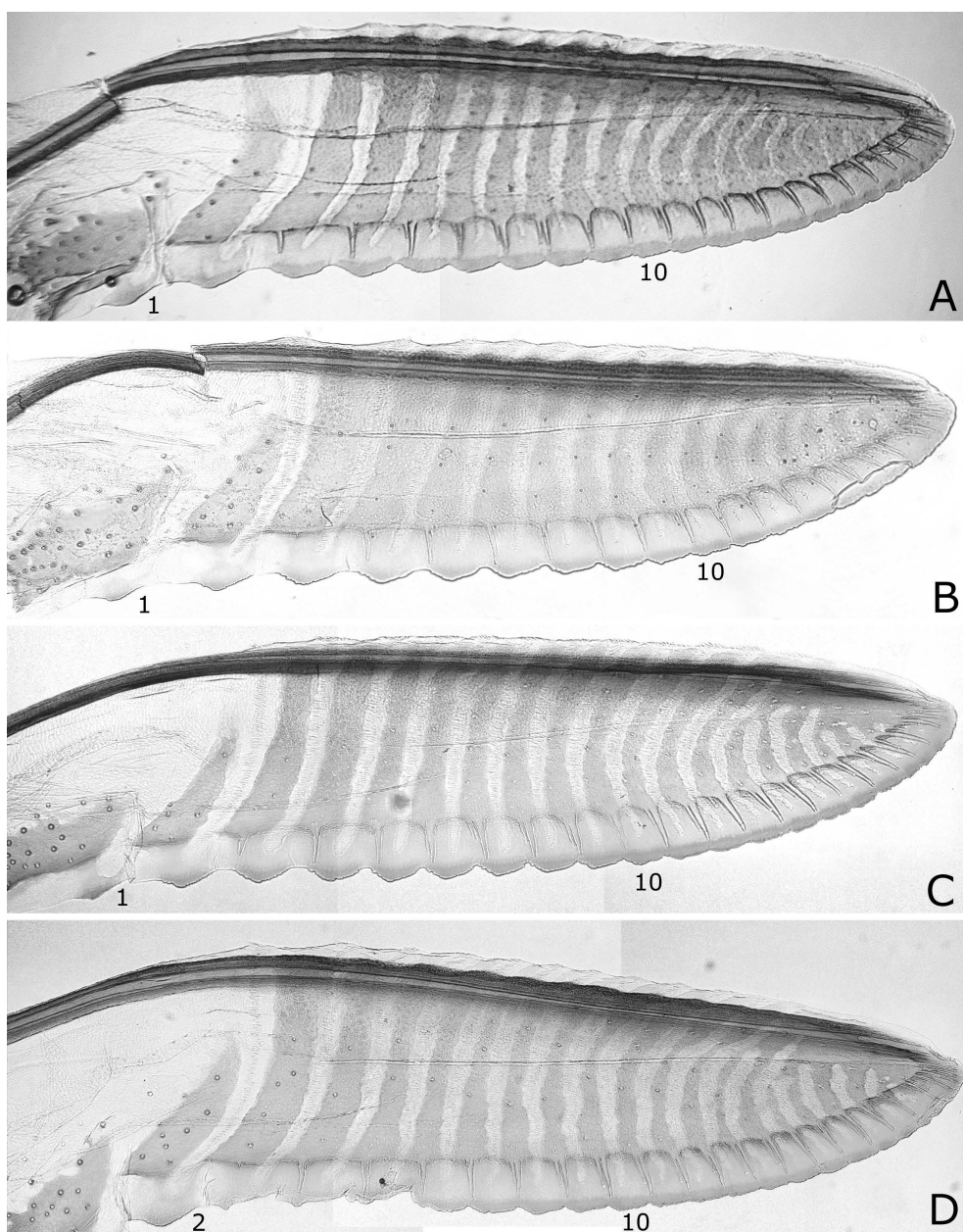


Fig. 5. Lancet of *Arge kobayashii*: A, Holotype; B, paratype, Sakhalin; C, Souknyo; D, Shima-onsen. Numerals 1, 2, 10, First (most basal), second and tenth serrulae.

rounded or truncate (Figs. 1D, 6A), rarely slightly notched. Genital capsule (Fig. 6A–C) in ventral view with basiparamere posteriorly not narrowed, harpe small, shorter and narrower than apical width of basiparamere; valviceps in dorsal view with lateral margin roundly convex near

apex and at middle, in lateral view (Fig. 6D) apically curved dorsally with rounded apex, at middle with round ventral lobe, basally with round ventral lobe and small dorsal apodemal extension.

Immature stages. Structure of final instar

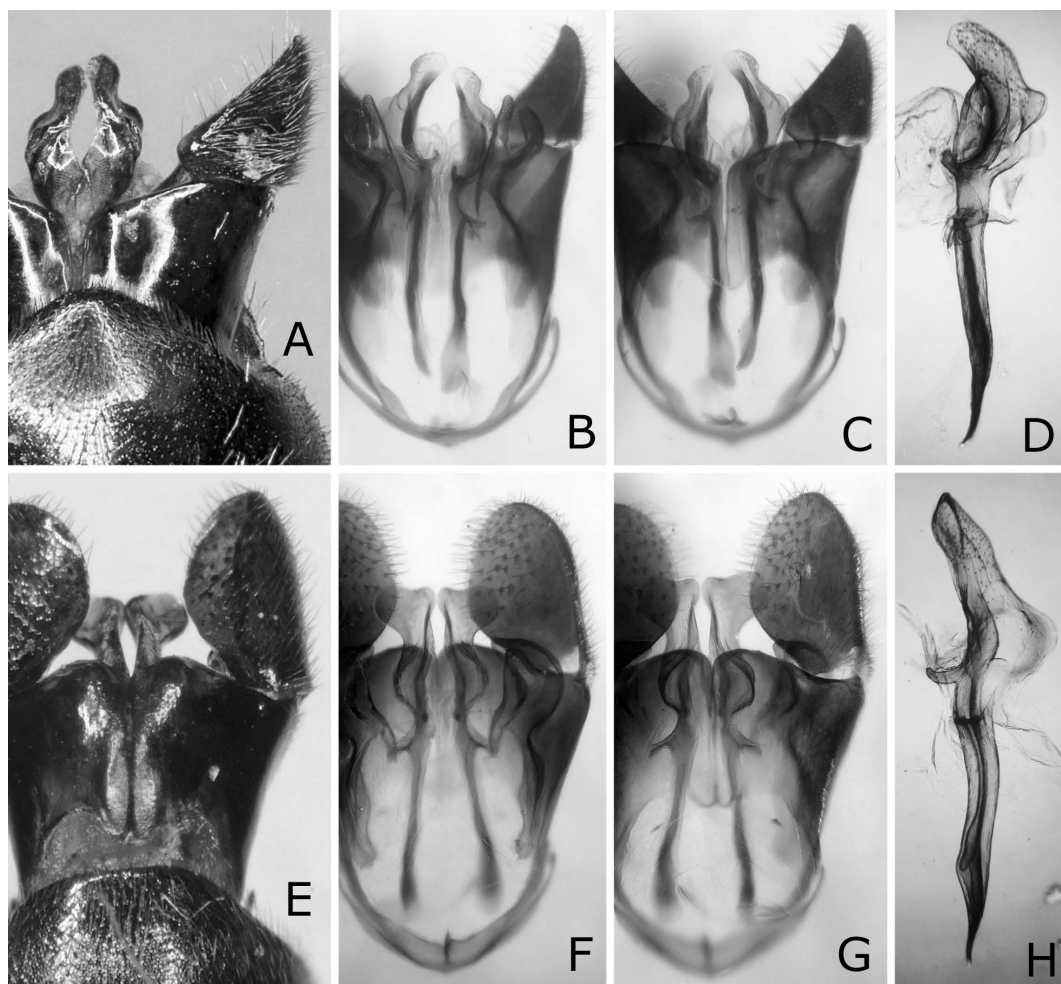


Fig. 6. Male genitalia. A, C, E, G, Ventral view; B, F, dorsal view; D, H, penis valve, lateral view, left dorsal. A–D, *Arge solowiyofka*: A, Chino; B–D, Kamishihoro. E–H, *Arge kobayashii*: E, Hidaka; F–H, offspring of HH040620A.

larva: Length 20 mm; antenna hemispherical, not flattened; clypeus with two pairs of setae; labrum with two pairs of setae; mandible with four to five setae on outer surface; proleg present on second to sixth and tenth abdominal segments; tenth proleg not extending posteriorly; tenth abdominal tergum in dorsal view widely rounded. For the larval coloration and the cocoon, see Hara *et al.* (2007).

Material examined. Holotype (Fig. 1A, B): ♀ labeled “Saghalin, Oguma”, “[Soroyofuka (in Japanese letters)], 10/7”, “Type”, and “HOLO-TYPE, *Hylotoma solowiyofkum* Matsumura, D.

R. Smith” (HU). Matsumura (1911) described this species on the basis of “*einem Exemplar*” (the sex was not mentioned). The above female specimen labeled “Type” agrees with the original description, and it is safely regarded as the holotype.

Other material examined: JAPAN — HOKKAIDO: 1 ♀, Rebun-to Is., 13. VII. 1955, K. Hattori; 1 ♀, same locality, 24. VII. 1956 (KU); 1 ♂, Rishiri-to Is., 29. VII. 1956; 1 ♂, same locality, 29. VII. 1956, O. Sato; 2 ♀ 4 ♂, same locality, 25–26. VI. 1990, A. Shinohara; 3 ♂, do., but 27. VI. 1990; 1 ♂, Shari, Mt. Chien-

- betsu-dake, 3. VIII. 1960, S. Takano; 1 ♀, Shari, Mt. Rausu-dake, 29. VII. 1963, K. Tanaka (MNHAH); 2 ♀, Rausu, 5–6. VIII. 1956, O. Sato; 1 ♀, Akkeshi, 29. VII. 1954, Takeuchi, T. Nakane (OPU); 1 ♂, Kamishihoro, Tokachimitsumata, 10. VII. 1996, A. Shinohara; 1 ♀, Kamishihoro, Horoka, 1. VIII. 1978, A. Shinohara; 2 ♀, Kamishihoro, Nukabira, 22. VII. 1975, E. Nishida; 1 ♂, Kamishihoro, Horoshikato, 10. VII. 1996, A. Shinohara; 8 ♂, same locality, 22. VI. 2003, H. Hara; 1 ♀ 3 ♂, same locality, 22. VI. 2003, A. Shinohara; 7 ♂, same locality, 23–24. VI. 2005, H. Hara and A. Shinohara; 1 ♀, Shikaoi, Yamada-onsen, 29. VII. 1973, A. Shinohara; 1 ♀, do., but 7. VII. 1994; 1 ♀, do., but 11. VII. 1998; 2 ♂, do., but 24–25. V. 2005, H. Hara; 5 ♂, do., but 24–25. V. 2005, H. Hara and A. Shinohara; 2 ♀, do., but 2. VII. 2011, H. Hara; 2 ♀, Shikaoi, Shikaribetsu-ko, 25. VII. 1939, Takeuchi; 2 ♂, same locality, 20. VI. 2000, A. Shinohara; 29 ♂, same locality, 22–24. VI. 2000, H. Hara; 4 ♂, same locality, 20. VI. 2002, H. Hara; 1 ♂, same locality, 20. VI. 2002, A. Shinohara; 2 ♀, Shikaoi, Mt. Higashi-nupukaushi-nupuri, 31. VII. 1979, M. Yano; 1 ♀, Shikaoi, Kanno-onsen, 3. VIII. 1966; 2 ♀ 3 ♂, same locality, 18. VII. 1972, A. Shinohara; 1 ♀, Nakasatsunai, Satsunai-gawa, Nananosawa, 20. VII. 1983, Y. Nishijima [cited by Togashi, 1998b as *Arge jonasi*]; 1 ♀ 2 ♂, Nayoro, Mt. Piyashiri-dake, 22–23. VI. 1990, A. Shinohara; 1 ♀ 2 ♂, do., but 26. VI. 2009; 10 ♂, same locality, 26. VI. 2009, H. Hara; 2 ♂, same locality, 30. VI. 2012, A. Shinohara; 1 ♀, Mts. Daisetsu-zan, 21. VII. 1928, Y. Miwa (HU); 1 ♂, Kamikawa, Ginsendai, 12–14. VII. 2001, A. Shinohara; 1 ♀, Kamikawa, Mt. Kuro-dake, 14. VII. 1962, K. Tsuji (KU); 1 ♂, same locality, 11. VII. 2001, A. Shinohara; 1 ♀, Kamikawa, Sounkyo, 17. VII. 1970, M. Sakai (EU); 1 ♀, same locality, 7–9. VII. 1971, K. Tanaka; 1 ♀, same locality, 18. VII. 1971, A. Shinohara; 3 ♀, same locality, 27, 30. VII. 1988, R. Inomata (MNHAH); 1 ♂, same locality, 17. VII. 1963, A. Nakanishi (KU); 1 ♂, same locality, 24. VII. 1962, T. Saigusa; 1 ♀, same locality, 6. VII. 1980, A. Shinohara; 1 ♀, Higashikawa, Yukomanbetsu, Asahidake-onsen, 20. VII. 1973, A. Shinohara; 1 ♀, same locality, 30. VI. 1990, H. Oishi (OMNH); 1 ♀, same locality, 27–28. VI. 1997, A. Shinohara; 1 ♀ 15 ♂, do., but 23–26. VI. 1998; 1 ♀ 24 ♂, same locality, 14. VII. 1998, H. Hara; 2 ♀ 9 ♂, same locality, 14. VII. 1998, A. Shinohara; 1 ♀, do., but 29–30. VI. 2000; 1 ♂, do., but 25–28. VI. 2001, A. Shinohara; 1 ♀, same locality, 22–23. VI. 2008, T. Naito; 1 ♀, same locality, 22–23. VI. 2008, A. Shinohara; 1 ♀, do., but 27–29. VI. 2009; 1 ♀, same locality, 1. VII. 2012, H. Hara; 1 ♀, Kamifurano, Mt. Tokachi-dake, 1. VIII. 1939, T. Sawamoto (HU); 1 ♂, Horokanai, Kitamoshiri, 30. VII. 1980, T. Shimomura; 1 ♂, Iwamizawa, Kurisawa, Mt. Sankakuyama, 19. VII. 1999, H. Hara; 1 ♂, Sapporo, Mt. Moiya-yama, 22. VII. 1984, S. Ohmomo; 1 ♀ (HH050717A), Hidaka, Nissho-toge, 17. VII. 2005, laid 14 eggs on *Betula ermanii* in cage, H. Hara; 3 final instar larvae (offspring of HH050717A), hatched 29–30. VII. 2005, fix. 16. VIII. 2005, H. Hara; 1 ♂, same locality, 17. VII. 2005, H. Hara; 1 ♀ 1 ♂, do., but 16. VII. 2011; 1 ♀ 1 ♂, Shizunai, Koiboku-rindo, Y. Nishijima; 1 ♀, Samani, Horoman, 25. VI. 1993, A. Shinohara; 1 ♀ 4 ♂, Kimobetsu, Nakayama-toge, 8. VII. 1996, A. Shinohara; 5 ♀ 4 ♂, do., but 13–15. VII. 1996; 2 ♀, do., but 14. VII. 1997; 1 ♂, do., but 18. VII. 1998; 2 ♀ 1 ♂, do., but 1–2. VII. 2006; 1 ♀, Niseko, Goshiki-onsen, 13. VII. 1997, A. Shinohara; 1 ♀, Noboribetsu, Karurusu-onsen, 3. VIII. 1966; 1 ♂, Noboribetsu, Mt. Shihorei, 4. VIII. 1966; 1 ♂, Nanae, Mt. Yokotsudake, 19–20. VI. 2007, H. Hara; 1 ♀, Hakodate, 13. VIII. 1958, K. Tsuneki. — HONSHU — Aomori Pref.: 1 ♂, Towada, Takinomasa, 15. VII. 1984, M. Yamada; 1 ♀, Mt. Herai-dake, 9. VIII. 1987, M. Yamada; 1 ♂, Iwaki, Mt. Iwaki-san, 7. VII. 1995, M. Yamada; 1 ♂, do., but 27. VII. 1996; 1 ♀, do., but 3. VIII. 1996. — Iwate Pref.: 1 ♀, Yamagata, Hiraniwakogen, 26. VII. 1994, H. Suda (HSC); 1 ♀, Shizukuishi, Mt. Sode-yama, 16. VII. 1974, T. Oku; 1 ♂, Shizukuishi, Kunimi-onsen, 27. VII. 1969, J. Kamei. — Fukushima Pref.: 1 ♂, Fukushima,

1. VIII. 1996, H. Nagase. — Tochigi Pref.: 1 ♀, Nasu, Sandogoya-onsen, 25. VII. 1970, T. Saito; 1 ♀, Nikko, Yunishigawa, 3. VII. 1994, T. Murakami; 1 ♂, Nikko, Yumoto, 10. VII. 1937, G. Yamamoto; 1 ♂, same locality, 25. VI. 1972, T. Saito; 1 ♀, do., but 2. VIII. 1972; 1 ♀, same locality, 27. VII. 1993, A. Shinohara; 1 ♂, Nikko, Yumoto, Karikomi-ko, 7. VIII. 1972, T. Saito. — Gunma Pref.: 2 ♂, Mt. Shirane-san, 14–15. VII. 2009, A. Shinohara; 1 ♂, Mt. Motoshirane-san, 26. VII. 2012, H. Kojima; 1 ♂, do., but 19. VII. 2013. — Yamanashi Pref.: 1 ♀, Mt. Kinpu-san, 1. VII. 1963, T. Naito (KU); 1 ♀ 1 ♂, Hokuto, Sutama, Masutomi, 6. VIII. 1986, A. Shinohara; 1 ♂, Narusawa, 27. VIII. 1997, H. Nagase. — Niigata Pref.: 1 ♀, Yuzawa, Mikuni, Asagai, 22. VI. 1987, S. Nishigaki; 1 ♀, Myoko, Sasagamine, 9. VIII. 1973, A. Shinohara; 1 ♀, “Nojiri, Echigo, Takeuchi” “T. Nakane” (OPU). — Nagano Pref.: 1 ♂, Yamanouchi, Shiga-kogen, 3–6. VIII. 1982, M. Sato; 1 ♀ (AS070806C), same locality, larva coll. 6. VIII. 2007, matured 18. VIII., em. 27. IX. 2007, Host: *Betula ermanii*, A. and N. Shinohara; 1 ♀ (AS070820B), same locality, larva coll. 20. VIII. 2007, matured 25. VIII., em. 12. IX. 2007, Host: *Betula ermanii*, A. Shinohara; 1 ♀ (AS070820C), same locality, larva coll. 20. VIII. 2007, matured 26. VIII., em. 13. IX. 2007, Host: *Betula ermanii*, A. Shinohara; 1 ♀ (AS070904F), same locality, larva coll. 4. IX. 2007, matured 7. IX., em. 5. V. 2008, Host: *Betula ermanii*, A. and N. Shinohara; 6 ♂, Yamanouchi, Mt. Kasagadake, offspring of female collected as larva, egg laid 1. IX., made cocoon 2. X., emerged 16–28. X. 2005, Host: *Betula ermanii*, H. Kojima; 1 ♀ (AS110805B), same locality, larva coll. 5. VIII. 2011, mat. 14. VIII., em. 4. IX. 2011, Host: *Betula ermanii*, A. Shinohara; 1 ♂, same locality, 2. VII. 2013, H. Kojima; 1 ♀, Yamanouchi, “Tomi-one”, em. 17. V. 2009, Host: *Betula corylifolia*, H. Kojima; 1 ♀ 3 ♂, Takayama, Yamada-bokujo, 28. VII. 2012, H. Kojima; 1 ♀ 2 ♂, same locality, 28. VII. 2012, A. Shinohara; 1 ♀, same locality, 30. VII. 2012, H. Kojima; 2 ♀, do., but 31. VII. 2012; 1 ♂, Takayama, Mt. Omeshi-dake,
23. VI. 2005, H. Kojima; 1 ♂, do., but 8. VII. 2010; 1 ♀, Takayama, Manzanbo, 14. VII. 2010, H. Kojima; 1 ♀, Tomi, Jizo-toge, 30. VII. 2010, H. Kojima; 1 ♂, Komoro, Takamine-onsen, 30. VII. 2010, H. Kojima; 1 ♂, Komoro, Kurumazaka-toge, 1. VIII. 1980, K. Mizuno; 1 ♂, Mt. Asama-yama, 24. VII. 1972, H. Kurahashi; 1 ♀, same locality, 27–28. VII. 1972, M. Kuboki; 1 ♀, Suwa, Kirigamine, 8–9. VIII. 2008, A. and N. Shinohara; 1 ♀, do., but 17–18. VIII. 2008; 1 ♀, Chino, Shibunoyu, 11. VII. 1974, T. Naito (KU); 1 ♀, same locality, 4. VII. 1978, A. Shinohara; 1 ♀, Chino, Mts. Yatsugatake, Minoto, 6. VIII. 1982, A. Shinohara; 1 ♂, do., but 7. VIII. 1982; 3 ♀ 1 ♂, do., but 29. VII. – 3. VIII. 1986; 3 ♀, do., but 4–8. VIII. 1987; 5 ♀, do., but 6–9. VIII. 1991; 12 ♀ 6 ♂, do., but 23–26. VII. 1996; 6 ♀ 1 ♂, do., but 31. VII. – 1. VIII. 1997; 1 ♂, do., but 27–31. VII. 1999; 3 ♀, do., but 25–29. VII. 2000; 6 ♀ 1 ♂, do., but 31. VII. – 1. VIII. 2005; 3 ♀, do., but 27–28. VII. 2006; 1 ♂, Ina, Mt. Nyukasa-yama, 31. VII. 1983, Y. Nishimoto; 2 ♀, do., but 24–25. VII. 1991; 1 ♂, do., but 8. VIII. 1997; 1 ♂, Mt. Senjogatake, 22. VII. 1962, F. Nagasuiji; 2 ♂, Ina, Kitazawa-toge, 25. VII. 1991, Y. Nishimoto; 1 ♀, Otari, Tsugaike, 6–8. VIII. 1999, A. Shinohara; 1 ♀, Omachi, Ogisawa, 22. VII. 1987, A. Shinohara; 1 ♂, Azumino, Nakabusa-onsen, 11. VIII. 1976, Y. T. and H. Suda (HSC); 2 ♀, Kamikochi, 19. VII. 1915 (KU); 1 ♂, same locality, 10. VII. 1918, K. Sato (KU); 1 ♂, same locality, 21. VII. 1966, T. Naito (KU); 1 ♂, do., but 14. VII. 1968; 1 ♂, same locality, 46. VII. 1989, A. Shinohara; 1 ♀ 3 ♂, do., but 18–20, 22. VII. 1989; 1 ♀, do., but 4. VIII. 1990; 1 ♀, Matsumoto, Abo-toge, 3. VIII. 1953, Takeuchi; 1 ♀, Matsumoto, Shimashima-dani, 18. VII. 1938; 1 ♂, same locality, 23. VII. 1968, A. Shinohara; 1 ♀, do., but 26. VII. 1969; 1 ♂, “Nagano, Ryômata” 17. VII. 1963, A. Nakanishi (KU). — Ishikawa Pref.: 1 ♀, Nakanoto, Mt. Sekido-san, 26. V. 1963 [probably cited by Togashi, 1998a as *Arge jonasi*]; 1 ♀, same locality, 8. VI. 1975, I. Togashi [probably cited by Togashi, 1998a as *Arge jonasi*]; 1 ♀, Mt. Haku-san, 23. VII. 1970;

1 ♀, same locality, 30. VII. 1992, I. Togashi “*Arge jonasi* (Kirby)”; 1 ♀, same locality, 29. VI. 2004, I. Togashi; 1 ♀, Mt. Rokuman-zan, 20. VII. 1985, I. Togashi. — Kyoto Pref.: 1 ♀, Miyama, Ashiu, 13. VI. 1976, K. Mizuno; 1 ♀, do., but 1–2. VII. 2000. — Osaka Pref.: 1 ♀, Kaizuka, Mt. Izumikatsuragi-san, 20. VIII. — 2. IX. 2002, R. Matsumoto (OMNH). — Hyogo Pref.: 1 ♀, Shin-onsen, Hataganaru, 20. VI. 1999, S. Goto, B1-479013 (MNHAH) [cited by Naito *et al.*, 2004 as *Arge jonasi*]; 1 ♀, Shin-onsen, Mt. Oginosen, 31. VII. 1999, T. Naito, B1-479014 (MNHAH) [cited by Naito *et al.*, 2004 as *Arge jonasi*]; 1 ♀, Haga, Onzui-keikoku, 14. VI. 1992, T. Morita, B1-212622 (MNHAH) [cited by Naito *et al.*, 2004 as *Arge abelivora*]; 1 ♂, Haga, Akazai-keikoku, 12. VI. 1992, T. Suzuki, B1-212623 (MNHAH) [cited by Naito *et al.*, 2004 as *Arge abelivora*]; 1 ♀, same locality, 21. V. 2000, T. Naito, B1-479390 (MNHAH) [cited by Naito *et al.*, 2004 as *Arge jonasi*]; 1 ♀, same locality, 8. VI. 2000, T. Ikeda, B1-479389 (MNHAH) [cited by Naito *et al.*, 2004 as *Arge jonasi*]; 1 ♀, same locality, 17. VI. 2001, H. Yoshida (KU). — SHIKOKU — Ehime Pref.: 1 ♀, Mt. Ishizuchi-yama, 24. VIII. 1949, Takeuchi, M. Miyatake (OPU); 1 ♀, Mts. Ishizuchi-yama, Tsuchi-goya, 22. VIII. 1999, M. Shiraishi; 1 ♀, same locality, 24. VI. 2003, A. Shinohara. — KYUSHU — Nagasaki Pref.: 1 ♀, Mt. Tara-dake, 16. VII. 1973, S. Kinoshita (EU) — Miyazaki Pref.: 1 ♂, Shiiba, Mt. Shiratori-yama, 13. VII. 1996, S. Ueno. — ETOROFU (ITURUP) IS.: 1 ♀, “Shana”, 9. VII. 1927, K. Doi (HU) [probably cited by Takeuchi, 1934 as *Arge jonasi*, ♂]; 1 ♀, do., 10. VII. 1927 (OPU) [probably cited by Takeuchi, 1934 as *Arge jonasi*, ♂]; 1 ♀, do., “*Arge usutulata* [sic] L., Det. C. Watanabe” (HU) [probably cited by Takeuchi, 1934 as *Arge jonasi*, ♂]; 1 ♀, do., “*Arge jonasi* Kirby, Det. K. Takeuchi” (HU) [cited by Takeuchi, 1934 as *Arge jonasi*, ♂]; 1 ♀, “[Beppi]” (in Japanese), 11. VII. 1927, K. Doi (OPU) [probably cited by Takeuchi, 1934 as *Arge jonasi*, ♂]; 1 ♀ 1 ♂, “[Kamuikotan]” (in Japanese), 20. VII. 1927, K. Doi (HU) [the female is probably cited by Takeuchi,

1934 as *Arge jonasi*]; 1 ♀, “[Sechu-Rubetsu]” (in Japanese), 3. VIII. 1927, K. Doi (HU) [probably cited by Takeuchi, 1934 as *Arge jonasi*, ♂]; 1 ♂, “[Iribushi]” (in Japanese), 17. VIII. 1927, K. Doi (HU) [cited by Takeuchi, 1934 as *Arge jonasi*]. RUSSIA — SAKHALIN: 1 ♀, “Ichinozawa”, 29. VII. 1924, Matsumura (OPU) [probably cited by Takeuchi, 1936 as *Arge jonasi*]; 1 ♀, “Kawakami”, 30. VII. 1924, Matsumura, “*solowiyofkum Mats*” (OPU) [cited by Takeuchi, 1936 as *Arge jonasi*]; 1 ♀, “Anfg. Aug. 1924, Saghalien, T. Kano” “*Arge jonasi* Takeuchi, Takeuchi, 1932, KES” (OMNH) [cited by Takeuchi, 1932 as *Arge jonasi*; see also Hara and Shinohara, 2014a]; 1 ♀, “Horo”, 12. VIII. 1931, K. Tamanuki (OPU) [cited by Takeuchi, 1936 as *Arge jonasi*]. — Locality unknown: 1 ♂, “7/13” (KU); 1 ♀ (MNHAH). For more material, see Hara *et al.* (2007).

Distribution. Japan: Hokkaido (Hara *et al.*, 2007), Honshu (Hara *et al.*, 2007), Shikoku (new record), Kyushu (new record), Etorofu Isl. (new record). Russia: Sakhalin (Type-locality), Primorskiy kray (Sundukov, 2009).

Sundukov (2009) and Lelej (2012) included China and Mongolia in the distribution of *A. solowiyofka*. This is doubtful because it was probably based on the distribution records of *A. jonasi* (Kirby, 1882), which was previously regarded as the senior synonym of *A. solowiyofka* (see also Hara and Shinohara, 2014a).

Biology. Host plant: *Betula corylifolia* Regel et Maxim. (new record), *B. ermanii* Cham. (Hara *et al.*, 2007) (Betulaceae). For the life history, see Hara *et al.* (2007).

Remarks. *Arge solowiyofka* is similar to *A. aciculata* Hara and Shinohara, 2014, *A. dimidiata* (Fallén, 1808), *A. enkianthus* Hara and Shinohara, 2012, *A. jonasi* (Kirby, 1882), *A. kobayashii* and *A. obesa* Hara and Shinohara, 2012 in the general coloration and in having the weakly carinate or rounded median ridge of the supraclypeal area and the glabrous or scarcely ciliate apical wing margins. *Arge solowiyofka* is distinguished from these species by the very feeble, almost unrecognizable blue metallic reflec-

tion (Fig. 1A–D), the moderate-sized frontal pit (Fig. 2B, E), the interantennal carinae usually dorsally curved medially (Fig. 2B, E), the usually apically darkened hind tibia and the entirely yellow veins C and Sc of the forewing in both sexes (Fig. 1A–D), the apically rounded ovipositor sheath (Fig. 3B, D) and the nearly straight or slightly sinuate middle annuli of the lancet in the female (Fig. 5), and the apically wide basiparamere (Fig. 6A), the small harpe and the characteristic valviceps in the male (Fig. 6A–D). In the key to the Palearctic species by Gussakovskij (1935), *A. solowiyofka* goes to *A. jonasi*, but differs from the latter as stated above. For more

comparison with the similar species, see Hara and Shinohara (2012a, 2014a, b) and Hara *et al.* (2012).

The larva of *A. solowiyofka* appear to be indistinguishable from that of *A. dimidiata* (Hara and Shinohara, 2014b). These two species and *A. aenea* Hara and Shinohara, 2008, *A. kobayashii* and *A. pullata* Zaddach, 1859 are known to be associated with *Betula* in Japan. A key to these five Japanese *Arge* species in the late larval instar (more than 15 mm long) is as follows (see also Hara *et al.*, 2007; Hara and Shinohara, 2008a, b, 2014b).

1. Head and legs black; trunk with three pairs of longitudinal rows of black spots dorsally and subspiracular lobes each with large black spot. [Prolegs present on second to seventh or eighth and tenth abdominal segments.]..... *A. pullata*
- Head and legs each widely pale; trunk at most with pair of longitudinal rows of small black spots on thorax dorsally..... 2
2. Seventh abdominal segment with pair of prolegs; head with dark brown longitudinal median stripe; subspiracular lobes greenish, concolorous with other parts of trunk..... *A. kobayashii*
- Seventh abdominal segment without pair of prolegs; head with dark brown inverted Y marking; subspiracular lobes pale yellow, conspicuously different in color from greenish dorsum of trunk... 3
3. Frons green white; antenna rather flattened..... *A. aenea*
- Frons creamy white; antenna conical or hemispherical..... *A. solowiyofka* or *A. dimidiata*

The late instar larva of another Japanese argid feeding on *Betula*, *Spinarge flavicostalis* Hara and Shinohara, 2006, is very characteristic in its almost entirely creamy white coloration (Shinohara *et al.*, 2013) and easily separated from the larvae of the five *Arge* species keyed above.

Arge kobayashii Takeuchi, 1931

Japanese name: Ao-unmon-churenji (new name)

(Figs. 1E–N, 2G–L, 3F–J, 5, 6E–H)

Arge kobayashii Takeuchi, 1931: 30; Takeuchi, 1932: 36; Takeuchi, 1934: 24; Takeuchi, 1936: 63; Takeuchi, 1939: 408; Abe and Togashi, 1989: 543; Togashi, 1998b: 39; Togashi, 2002: 9; Hara *et al.*, 2007: 88; Lelej and Taeger, 2007: 943; Taeger *et al.*, 2010: 132; Yoshida, 2010: 21; Hara and Shinohara, 2012a: 31; Hara and Shinohara, 2012b: 85; Hara *et al.*, 2012: 140; Lelej, 2012: 64; Shinohara and Hara, 2013: 36; Hara and Shinohara, 2014a: 84, 96, 98.

Arge fuscipes var. *expansa*: Gussakovskij, 1935: 278, 424 [part]. [Not Klug, 1834.]

Arge fuscipes: Takeuchi, 1936: 64. [Not Fallén, 1808.]

Arge jonasi: Takeuchi, 1937: 30. [Not Kirby, 1882.]

Arge fuscipes expansa: Takeuchi, 1955: 9. [Not Klug, 1834.]

Arge hasegawae: Togashi, 2002: 9 [part]. [Not Takeuchi, 1927]. See Shinohara *et al.* (2011).

Redescription. *Female and male.* Length 8.0–12.0 mm in female (Fig. 1E–G), 8.0–11.0 mm in male (Fig. 1H, I). Head and body black with distinct blue green to blue metallic reflection; reflection often purple metallic on basal abdominal terga. Antenna black, without metallic reflection. In legs, coxae to femora black with blue metallic reflection; fore tibia brown; middle and hind tibiae yellow, dark brown apically; tarsi dark brown, usually basally yellow to brown; tibial spurs yellow. Wings hyaline,

slightly yellowish; black marking below stigma posteriorly extending to vein M (Fig. 1E), sometimes to posterior wing margin but weakened beyond vein M (Fig. 1G); in forewing, stigma black, apically yellow brown narrowly, rarely yellow brown on apical half, cells C and Sc yellow, veins black, yellow on C and Sc, most of apical section of R1, base of M + Cu and most of A (rarely C darkened along anterior margin). Setae brownish dorsally, whitish laterally and ventrally.

Head in dorsal view distinctly swollen behind eyes in female (Fig. 2G), not or slightly so in male. Median ocellus distinctly raised; glabrous area around median ocellus wide (Fig. 2H, K). Frontal area anterolaterally distinctly convex. Frontal pit small and rather deep. Interantennal carinae dorsally curved medially and narrowly separated from each other (Fig. 2H, K) (not curved medially and widely separated from each other in one male), ventrally converging to each other and becoming low or inconspicuous (Fig. 2I, J, L); blunt throughout in female, sharp but dorsally and ventrally blunt in male. Supraclypeal area with median ridge rounded or weakly carinate, and side slope flat or weakly rounded. Clypeus not widely flattened (predominantly flattened in one male). Antenna normal; in male, length $2.1\text{--}2.7 \times$ head width. Right mandible not or slightly notched on inner margin (Fig. 2J). In forewing, cell 1Rs2 with anterior length $0.9\text{--}1.3 \times$ posterior length; crossvein 3r-m roundly curved (Fig. 1E, G, H). In both wings, margin between veins Rs and Cu glabrous, with marginal glabrous area about as wide as width of vein M and marginal setae at most about as long as width of vein M (Fig. 3F). Dorsum of abdomen smooth, and in female almost glabrous on second to fourth terga except for narrow lateral areas, glabrous medially and setose laterally on fifth tergum, and setose almost all over on sixth and more posterior terga.

In female, seventh sternum normal. Ovipositor sheath (Fig. 3G–I) in posterodorsal view about as long as wide or slightly longer than wide, with lateral margin basally rounded and apically

straight or weakly rounded, and apex pointed (in only two females from Hokkaido and Sakhalin, apex narrowly rounded as in Fig. 3D). Lance with several very narrow membranous areas midapically (Fig. 3J). Lancet (Fig. 5) with about 19–22 serrulae, without row of setae (= ctenidium) before first annulus, dorsoapically with narrow nonannulated area; middle and apical annuli arched toward base of lancet; basal and middle serrulae rounded or nearly pointed apically, each with anterior slope shorter than posterior slope; apical serrulae weakly but distinctly convex.

In male, subgenital plate apically rounded or truncate (Fig. 6E). Genital capsule (Fig. 6E–G) in ventral view with basiparamere posteriorly not narrowed; harpe large, about as long as and narrower than apical width of basiparamere; valviceps in dorsal view with large apical lobe, in lateral view (Fig. 6H) basally with large ventral lobe and long dorsal apodemal extension.

Immature stages. Middle and semifinal instar larvae (Fig. 1J): Head brown to dark brown in middle instar; yellow brown with dark brown stripe in semifinal instar as in Fig. 1K. Trunk light green, covered with minute dark spots, dorsally with pair of longitudinal rows of black spots on pro- and meso-thoraxes and pair of whitish stripes; subspiracular lobes centrally darkened; tenth tergum sometimes black posteriorly in middle instar. Legs pale green, apically brownish, in middle instar basally darkened.

Final instar larva (Fig. 1K–N): Length 18–22 mm. Coloration as in semifinal instar, but head creamy and minute spots on trunk often inconspicuous. Antenna very short and apically flattened or nearly so. Clypeus with two pairs of setae. Labrum with two pairs of setae. Mandible with three to four setae on outer surface. Proleg present on second to seventh and tenth abdominal segments; tenth proleg not extending posteriorly. Tenth abdominal tergum in dorsal view widely truncate posteriorly. Setae distinct.

Cocoon: Length 10–13 mm in female, 5.0–6.5 mm in male; pale brown or brown; elongate oval, double walled; outer wall netted; inner wall parchment like.

Material examined. Holotype (Fig. 1E, F): ♀ labeled “2, VIII, 1931, Shikotan, Takeuchi”, “*Arge kobayashii*” and “*Arge kobayashi [sic]*” Takeuchi, HOLOTYPE, D. R. Smith” (OPU). Paratype: 1 ♀, “11, VII, 1930, Mt. Suzuya, Takeuchi” (OPU).

Other material examined: JAPAN — HOKKAIDO: 1 ♀, Rebun Is., 27. VII. 1951, M. Konishi (HU); 1 ♀, Rishiri Is., 20–22. VII. 1971, K. Tanaka; 5 ♀ 3 ♂, same locality, 25–27. VI. 1990, A. Shinohara; 1 ♀, Toyotomi, Maruyama, 2. VIII. 1961, G. Kuno (HU); 2 ♂, Shari, Mt. Rausu-dake, 22. VII. 1967, T. Naito; 1 ♀, same locality, 14–17. VII. 1980, T. Shimomura; 1 ♀, Nakashibetsu, Kenebetsu, 2. VIII. 1973, T. Kumata (HU); 1 ♂, Ashoro, Mt. Kumaneshiridake, 1. VIII. 1967, Y. Nishijima; 1 ♀, Kamishihoro, Horoka, 15–22. VII. 1971, M. Kuboki; 1 ♀, Kamishihoro, Horoshika-toge, 7. VII. 1994, A. Shinohara; 1 ♀, do., but 28–30. VI. 1995; 1 ♀, do., but 21–25. VI. 1997; 1 ♀, do., but 16. VII. 1997; 1 ♂, same locality, 27. VI. 1999, H. Hara; 7 ♂, do., but 22. VI. 2003; 16 ♂, same locality, 23–24. VI. 2005, H. Hara and A. Shinohara; 1 ♂, same locality, 23–25. VI. 2006, H. Hara; 9 ♀ 3 ♂, same locality, 27–29. VI. 2012, H. Hara and A. Shinohara; 1 ♀, Shikaoui, Yamada-onsen, 28–30. VI. 1995, H. Hara; 1 ♀ (HH040620A), same locality, 20. VI. 2004, laid 49 eggs in leaf margins of *Betula ermanii*, H. Hara; 3 ♂ (offspring of HH040620A), eggs laid 20–25. VI. 2004, larvae hatched 27–?. VI., coc. 13–23. VII., em. 22. IV. – 10. V. 2005, H. Hara; 3 final instar larvae (offspring of HH040620A), eggs laid 20–25. VI. 2004, larvae hatched 27–?. VI., fix. 23. VII., H. Hara; 16 ♂, same locality, 20–21. VI. 2004, H. Hara and A. Shinohara; 6 ♂, same locality, 25. VI. 2005, H. Hara; 3 ♂, Shikaoui, Shikaribetsu-ko, 22–24. VI. 2000, H. Hara; 3 ♂, do., but 20. VI. 2002; 1 ♀, Shikaoui, Mt. Higashi-nupukaushi-nupuri, 31. VII. 1979, M. Yano; 1 ♀ 1 ♂ (HH940714C), Shintoku, from two gregarious larvae on *Betula platyphylla* var. *japonica* coll. 14. VII. 1994, mat. 18. VII., em. 20, 24. IV. 1995, H. Hara; 1 ♀ 6 ♂, Nayoro, Mt. Piyashiri-dake, 22–23. VI. 1990, A. Shinohara;

12 ♂, same locality, 26. VI. 2005, H. Hara; 2 ♂, do., but 26. VI. 2009; 1 ♂, same locality, 30. VI. 2012, A. Shinohara; 1 ♀, Kamikawa, Mikunitoge, 1. VIII. 1984, S. Ohmomo; 1 ♀, Kamikawa, Mts. Daisetsu-zan, 24. VII. 1956, S. Ueda (EU); 3 ♀ 5 ♂, Kamikawa, Mts. Daisetsu-zan, Ginsendai, 12–14. VII. 2001, A. Shinohara; 1 ♂, do., but 17–18. VII. 2002; 1 ♂, same locality, 23. VI. 2003, H. Hara; 1 ♀, Kamikawa, Mts. Daisetsu-zan, Mt. Kuro-dake, 11. VII. 2001, A. Shinohara; 1 ♀, Kamikawa, Sounkyo, 17. VII. 1970, M. Sakai (EU); 1 ♀, same locality, 25. VI. 1989, R. Inomata (MNHAN); 1 ♀, Kamikawa, Aizankei, 10. VII. 1967, T. Naito; 1 ♀, same locality, 10–12. VII. 1971, K. Tanaka; 2 ♀, same locality, 13, 19. VII. 1971, A. Shinohara; 3 ♀, do., but 11–14. VII. 1972; 3 ♀ 3 ♂, Higashikawa, Mts. Daisetsu-zan, Asahidake-onsen, 23–26. VI. 1998, A. Shinohara; 1 ♀ 1 ♂, same locality, 14. VII. 1998, H. Hara and A. Shinohara; 2 ♀ 1 ♂, same locality, 25–28. VI. 2001, A. Shinohara; 1 ♀ 2 ♂, do., but 25–28. VI. 2002; 1 ♂, do., but 24–26. VI. 2004; 4 ♂, same locality, 27. VI. 2006, H. Hara and A. Shinohara; 3 ♀ 2 ♂, same locality, 23–26. VI. 2007, A. Shinohara; 1 ♀, same locality, 22–23. VI. 2008, T. Naito; 1 ♂, same locality, 27–29. VI. 2009, A. Shinohara; 1 ♀, Bibai, 4. VI. 1996, H. Hara; 1 ♂, Iwamizawa, Kurisawa, Mt. Sankaku-yama, 11–14. VI. 1997, H. Hara; 1 ♀, Sapporo, 13. VI. 1979, A. Shinohara; 1 ♀, Sapporo, Misumai, 15. VI. 1979, H. Takahashi; 1 ♀ (HH040619A), Hidaka, Nissho-toge, 19. VI. 2004, laid 16 eggs in leaf margins of *Betula ermanii*, A. Shinohara; 1 ♀ (HH040619B), do., but laid 36 eggs in leaf margins of *Betula ermanii*, H. Hara; 5 final instar larvae (offspring of HH040619B), mat. and fix. 16. VII., H. Hara; 1 ♀ (HH040623A), same locality, 23. VI. 2004, laid 29 eggs in leaf margins of *Betula ermanii*, H. Hara; 5 final instar larvae (offspring of HH040623A), fix. 19, 23. VII., H. Hara; 1 ♀ 2 ♂, same locality, 23. VI. 2004, H. Hara and A. Shinohara; 1 ♂, same locality, 4. VII. 2004, H. Hara; 13 ♂, same locality, 22. VI. 2005, H. Hara and A. Shinohara; 1 ♀ 25 ♂, same locality, 9. VII. 2005, H. Hara; 14 ♂, do., but 2.

- VII. 2006; 1 ♂, do., but 15. VI. 2012; 1 ♂, Shinhidaka, Mt. Petegari-dake, 24. VII. 1970, R. Ishikawa; 1 ♂, Kimobetsu, Nakayama-toge, 25. VI. 1986, A. Shinohara; 1 ♂, do., but 18. VI. 1990; 1 ♀ 4 ♂, do., but 8. VII. 1990; 3 ♀, do., but 13–15. VII. 1996; 1 ♀, do., but 26. VI. 1997; 1 ♀, do., but 14. VII. 1997; 2 ♀ 3 ♂, do., but 30. VI. – 2. VII. 2006; 1 ♀, do., but 20. VI. 2011; 1 ♀ (HH070619A), Nanae, Mt. Yokotsu-dake, 19. VI. 2007, laid 14 eggs on leaf margins of *Betula ermanii*, A. Shinohara; 1 final instar larvae (offspring of HH070619A); 2 ♂ (offspring of HH070619A), eggs laid 20–22. VI., hatched 1–3. VII., coc. 18–25. VII., em. 5. V. 2008, H. Hara; 1 ♀ 15 ♂, same locality, 19. VI. 2007, H. Hara and A. Shinohara. — HONSHU — Miyagi Pref.: 1 ♂, Mt. Zao-san, Kamoshika-onsen, 24. VII. 1976, A. Shinohara. — Tochigi Pref.: 1 ♀, Nikko, Yumoto, 23. VI. 1971, T. Saito; 1 ♀, do., but 24. VI. 1971; 1 ♀, Nikko, “Koozawa”, 16. VII. 1978, H. Itami. — Gunma Pref.: 1 ♀, Oze, Sanpei-toge, 12. VII. 1951; 1 ♀, Katashina, Marunuma-onsen, 3. VI. 1971, H. Suda (HSC); 1 ♀, Nakanojo, Shima-onsen, 31. VII. 1993, K. Emoto; 1 ♀, Mt. Shirane-san, 25. VI. 2005, H. Kojima; 2 ♂, do., but 14–15. VII. 2009. — Yamanashi Pref.: 1 ♂, Narusawa, Mt. Fuji-san, 22. VII. 1980, N., T. and H. Suda (HSC). — Niigata Pref.: 1 ♀, Mt. Myoko-san, 19. VIII. 1973, A. Shinohara. — Nagano Pref.: 1 ♀, Yamanouchi, Shiga-kogen, 7–9. VIII. 1996, A. and T. Shinohara; 2 ♂ (AS070806B), same locality, larvae coll. 6. VIII. 2007, mat. 8. VIII, em. 11. VI. 2008, Host: *Betula ermanii*, A. and N. Shinohara; 4 ♂, Shiga-kogen, Mt. Kasagadake, 23. VI. 2013, H. Kojima; 7 ♂, do., but 28. VI. 2013; 2 ♂, do., but 2. VII. 2013; 1 ♂, Takayama, “[Ipponmatsu]”, 23. VI. 2005, H. Kojima; 1 ♂, Takayama, Mt. Omeshi-dake, 23. VI. 2005, H. Kojima; 1 ♂, do., but 8. VII. 2010; 2 ♀, Tomi, Jizo-toge, 30. VII. 2010, H. Kojima; 1 ♂, same locality, 7. VIII. 2013, A. Shinohara; 4 ♀, Komoro, Takamine-onsen, 30. VII. 2010, H. Kojima; 1 ♀, Tateshina, Tenshojihara, 29. VII. 1972, A. Shinohara; 1 ♀, Mts. Yatsugatake, 26. VII. 1970, A. Shinohara; 2 ♀, Chino, Mts. Yatsugatake, Minoto, 18. VII. 1980, A. Shinohara; 1 ♀, do., but 30. VII. 1982; 1 ♀, do., but 29. VII. – 3. VIII. 1986; 2 ♀, do., but 23–26. VII. 1996; 1 ♀, do., but 27–31. VII. 1999; 3 ♀, Mt. Nyukasa-yama, 25. VII. 1991, Y. Nishimoto; 1 ♀, Ina, Kitazawa-toge, 25. VII. 1991, Y. Nishimoto; 1 ♀, Ina, Kitazawa-toge – Umanose, 2. VIII. 1961, R. Inomata (MNHAH); 1 ♂, do., but 2. VIII. 1965 (MNHAH); 1 ♂, Mt. Senjogatake, 23. VII. 1962, F. Nakasuji; 1 ♀, same locality, 21. VII. 1962, T. Torii; 1 ♀, Otari, Tsugaike, 4. VIII. 2010, A. and N. Shinohara; 1 ♀ 1 ♂, Hakuba, Happo-one, 7. VIII. 1999, A. Shinohara; 2 ♀ 1 ♂, same locality, 2. VIII. 2012, H. Kojima and A. Shinohara; 1 ♀ 1 ♂, Kamikochi, 10. VII. 1918, K. Sato; 1 ♀, same locality, 20. VII. 1919, Takeuchi (OPU) [probably cited by Takeuchi, 1932]; 1 ♀, same locality, 15. VII. 1927, K. Sato; 1 ♂, same locality, VII. 1929, Y. Ohta (HU); 1 ♀, same locality, 1. VIII. 1931, Takeuchi, “*Arge kobayashii*” (OPU) [probably cited by Takeuchi, 1932]; 1 ♀, same locality, 1. VIII. 1931, Takeuchi, Obayashi (OPU) [probably cited by Takeuchi, 1932]; 1 ♀, same locality, 24. VII. 1948, I. Ito (OPU); 1 ♀, same locality, 20. VI. 1951, Takeuchi, Nakane (OPU); 1 ♀, same locality, 22. VII. 1952, S. Ito (OPU); 2 ♂, same locality, 10. VII. 1963, A. Nagatomi; 1 ♀ 1 ♂, same locality, 6. VII. 1964, T. Naito; 1 ♂, do., but 21. VII. 1966; 1 ♀, same locality, 4–6. VII. 1989, A. Shinohara; 14 ♀ 4 ♂, do., but 18–23. VII. 1989; 1 ♀, do., but 31. VII. 1990; 2 ♀ 1 ♂, same locality, 17. VII. 2011, Y. Kishida; 1 ♂, Tokugo-toge, 29. VI. 1930 (OPU); 1 ♀, same locality, 22. VII. 1937, Takeuchi, S. Miyamoto (OPU); 1 ♀, same locality, 27. VI. 1976, A. Shinohara; 1 ♀, Matsumoto, Shimashima-dani, 27. VII. 1936, Takeuchi, H. Takenaka (OPU); 1 ♂, same locality, 28. VI. 1976, A. Shinohara; 1 ♂, Mt. Norikura-dake, 27. VII. 1930, K. Kamiya; 1 ♀, “Daimonzawa”, 25. VII. 1972, T. Mikage. — Ishikawa Pref.: 1 ♀, Mt. Haku-san, 24. VII. 1937, Takeuchi (OPU); 1 ♀, same locality, 10. VII. 1971; 1 ♀ 1 ♂, same locality, 20. VII. 1977, I. Togashi; 1 ♀, do., but 5. VIII. 1993; 1 ♂, same locality, 10. VII. 1994, I. Togashi, “*Arge hasegawae* Takeuchi” [cited by

Togashi, 2002 as *Arge hasegawae* Takeuchi, 1927; see also Shinohara *et al.*, 2011]; 2 ♂, same locality, 8. VII. 1999, I. Togashi, "*Arge kobayashii* Takeuchi" [cited by Togashi, 2002]; 1 ♀, same locality, 11. VII. 2000, I. Togashi, "*Arge jonasi* (Kirby)". — Japan, locality unknown: 1 ♀, "Shozokuba", 23. VII. 1930; 1 ♀, "Ohsawa", 20. VII. 1972, T. Mikage. RUSSIA — Sakhalin: 1 ♂, "11, VII, 1930, Mt. Suzuya, Takeuchi" (OPU) [cited by Takeuchi, 1936 as *A. fuscipes*]; 1 ♀, "Konuma", 12. VII. 1931, K. Tamanuki (OPU) [cited by Takeuchi, 1936 as *A. fuscipes*]; 1 ♀, "Kasiho", 10. VII. 1933, Uchida, Okada and Sawamoto (OPU) [cited by Takeuchi, 1936 as *A. kobayashii*]; 1 ♀, "Hoye", 16. VII. 1933, Uchida, Okada and Sawamoto (OPU) [cited by Takeuchi, 1936 as *A. kobayashii*]; 1 ♂, "Kaibato" [= Moneron Is.], 20–25. VII. 1930, T. Shiraki (OPU) [cited by Takeuchi, 1937 as *A. jonasi*]. — Locality unknown: 1 ♀, no data.

Distribution. Japan: Hokkaido (Abe and Togashi, 1989; Togashi, 1998b), Honshu (Takeuchi, 1932), Shikotan Is. (type locality). Russia: Sakhalin (Takeuchi, 1931), Moneron Is. (new record).

Biology. Host plants: *Betula ermanii* Cham. (new record), *B. platyphylla* Sukaczew var. *japonica* (Miq.) H. Hara (new record) (Betulaceae).

Adults were collected from middle June to early August in Hokkaido and from early June to middle August in Honshu. Late instar larvae were collected middle July in Hokkaido and early August in Honshu. They became adults in the following year. This sawfly probably has one generation a year, and passes winter within a cocoon. Eggs were laid along leaf margins in rows in captivity. One to six larvae were found on a leaf or two or more adjacent leaves in the field. They were solitary or gregarious.

Remarks. Among the Japanese species, *A. kobayashii* is similar to *A. aciculata*, *A. enkianthus*, *A. jonasi*, *A. obesa* and *A. solowiyofka* in the general coloration and in having the weakly carinate or rounded median supraclypeal ridge and glabrous or scarcely ciliate apical wing mar-

gins. This species is distinguished from the latter five by the distinct blue metallic reflection and the mostly or entirely yellow veins C and Sc of the forewing in both sexes (Fig. 1E–I), the robust and apically pointed ovipositor sheath in dorsal view (Fig. 3G, I) and the arched middle annuli of the lancet in the female (Fig. 5), and the apically wide basiparamere, the large and apically rounded harpe and the large apical lobe of the valvices in the male (Fig. 6E–H) (see also Hara and Shinohara, 2012a, 2014a and Hara *et al.*, 2012). *Arge kobayashii* is structurally very similar to *A. takanebara* Hara and Shinohara, 2013 among the Japanese congeners. These two are members of the species group of *A. clavicornis* (Fabricius, 1781) defined by Smith (1989). The marking below the stigma is distinct in *A. kobayashii*, while it is inconspicuous in *A. takanebara* (see fig. 1A in Hara and Shinohara, 2013). The larva of *A. kobayashii* is distinguished from those of the other Japanese species associated with *Betula* in the key: see under the remarks on *A. solowiyofka*.

In the key to the Palearctic species by Gussakovskij (1935), *A. kobayashii* runs to *A. fuscipes*, or to the couplets of 172 and 175, but does not precisely agree with any of them. This species is distinguished from *A. fuscipes* by the mostly or entirely yellow veins C and Sc of the forewing. Gussakovskij (1935) synonymized *A. kobayashii* with "*A. fuscipes* Fall. var. *expansa* Kl.", but *A. kobayashii* does not run to that taxon in his key. His concept of "*A. fuscipes* Fall. var. *expansa* Kl." differs from both *A. expansa* and *A. kobayashii* in having the entirely pale hind tibia. The hind tibia is darkened apically in the latter two; see the photographs of the female syntype of *A. expansa* in Taeger and Blank (2011) and the holotype of *A. kobayashii* (Fig. 1E, F).

Takeuchi (1955) synonymized *A. kobayashii* with "*A. fuscipes expansa*", a combination proposed by Benson (1945, 1951). Indeed, *A. kobayashii* goes to that taxon in the key by Benson (1951) at least in the female. However, Benson's "*A. fuscipes expansa*" differs from *A. expansa* in having the pale veins C and Sc in the

female. The syntype of *A. expansa* (female) has the black veins C and Sc as in *A. fuscipes* (see the photographs in Taeger and Blank, 2011). Lindqvist (1973) examined the syntype of *A. expansa*, and synonymized *A. expansa* with *A. fuscipes*. Therefore, Benson's "*A. fuscipes expansa*" may be *A. kobayashii*.

Zhelochovtsev (1939) and Zhelochovtsev and Zinovjev (1988) treated *A. fuscipes* as a synonym of *A. ustulata*. Verzhutskii (1966) regarded both *A. fuscipes* and *A. expansa* as varieties of *A. ustulata*. On the other hand, Viitasaari (1990) separated *A. fuscipes* and *A. ustulata*. Blank and Taeger (1998) stated "In Central Europe color differences between *A. ustulata* and *A. fuscipes* are strikingly distinct". Although Taeger *et al.* (2010) listed these three taxa and *A. kobayashii* as distinct species, their classification has not been well established. We here only point out that in the coloration of the veins, stigma and hind tibia, namely the characters used to separate these species, Japanese specimens (more than 300 individuals examined) of *A. kobayashii* are very stable as shown in the redescription above, and we have not found any specimens identifiable with *A. ustulata*, *A. fuscipes* or *A. expansa* in Japan.

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