

Arge ibukii sp. nov. (Hymenoptera, Argidae) feeding on *Ulmus davidiana* var. *japonica* from Japan

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Abstract *Arge ibukii* Hara and Shinohara, sp. nov. (Hymenoptera, Argidae), belonging to the *Arge captiva* group, is described from Honshu, Japan. The larva is a solitary leaf-feeder of *Ulmus davidiana* Planch. var. *japonica* (Rehder) Nakai (Ulmaceae). The immature stages are described and the life history is outlined based on field observations and rearing records. A key to the species of the *A. captiva* group is provided.

Key words: Hymenoptera, Argidae, *Arge ibukii* sp. nov., *Arge captiva* group, *Ulmus*.

Introduction

The Iwamura Kazuo Ehon-no-oka Art Museum is a small but popular private art gallery located on a hill at an altitude of 180m in the beautiful countryside of Koisago, Nakagawa Town, Tochigi Prefecture in central Honshu, Japan. In the huge, mostly natural style garden of the museum, there are three large trees of Japanese elm, *Ulmus davidiana* Planch. var. *japonica* (Rehder) Nakai, which were planted there when the museum opened in 1998. The Japanese elm, distributed naturally in more northern or colder regions, is not native to this area, although another species of elm, the lacebark elm, *Ulmus parvifolia* Jacq., is common in the region. The three Japanese elm trees have nurtured a number of insect species and for over ten years have provided Ibuki with wonderful opportunities for observing the biology of sawfly larvae feeding on elm foliage.

On June 29, 2018, Ibuki found a strange sawfly larva on the leaves of the elm tree stated above. It apparently belonged to the argid genus *Arge* or *Spinarge* but distinctly differed from the larvae of the commonly encountered argid, *Arge captiva* (Smith, 1874), which are conspicuous and gregarious defoliators of elm. Ibuki's attempt to rear the single larva to the adult failed in 2018, but almost one year later, he found three larvae on the same tree and succeeded in obtaining two adults, a female and a male, by rearing them. The female oviposited and one male adult of the next generation emerged thereafter. The adults looked like those of *A. captiva*, but a close study has shown that they represent a new species belonging to the *A. captiva* group defined by Shinohara *et al.* (2009). Here we describe the new species and give notes on its life history. This is an addition to the 32 *Arge* species previously recorded from Japan (Hara and Shinohara, 2018) and the second species of *Arge* known to be associated with elm in the Old World.

Material and methods

The material used in this study is kept in the National Museum of Nature and Science, Tsukuba. Specimens of *Arge ibukii* are listed under the material examined. Figured specimens of other species are as follows: Fig. 3E, *A. captiva* (Smith, 1874), ♀, Japan, Hokkaido, Nayoro, 26. VI. 2009, H. Hara; Fig. 4B, *A. captiva*, ♀, Japan, Honshu, Kawasaki, 27. IV. 1989, H. Ono; Fig. 5F, *A. captiva*, ♂, Japan, Hokkaido, Sapporo, Hokkaido Univ., on *Ulmus pumila*, 7. VII. 2007, H. Hara, NSMT-HYM 60569; Fig. 5G, H, *A. captiva*, ♂, same data except for NSMT-HYM 60581.

Morphological examination was undertaken with a Leica MS5 stereo binocular microscope and Olympus BH-2 light microscope. Photographs were taken with digital cameras, Olympus TG-4 and TG-5 and CASIO EX-ZR1000, and a Sony DSC-RX100 digital camera with the microscopes above. The digital images were processed and arranged with Adobe Photoshop Elements 15[®] software.

Rearing was done by Ibuki in a room in Nakagawa Town, Tochigi Prefecture. The temperature and day length were not controlled in the room, but the light was usually on for about 16 hours a day.

For the morphological terminology, we followed Viitasaari (2002).

Results and discussion

Arge ibukii Hara and Shinohara, **sp. nov.**

Japanese name: Kiberi-nire-churenji
(Figs. 1–5; Table 1)

Description: Female (holotype) and male. Length 8.0 mm in female (Figs. 1A–D, 2A), 7.0–8.0 mm in male (Fig. 1E–H). Black with pronotum, mesoscutum except for posterolateral area and dorsal part of mesopleuron yellow red. Mandible apically reddish. Maxillary palp brownish except for basal palpomeres. Reflection on black areas generally weak green blue to blue metallic;

narrow inner orbit, clypeus and labrum brassy or purple; frontal area and interantennal area very narrowly or mostly brassy or purple. Wings dark brown, slightly pale apically; stigma black in female, dark brown in male; veins mostly black; vein C yellow, slightly darkened apically. Setae mostly whitish or yellowish.

Head in dorsal view dilated behind eyes (Fig. 1A, E). Frontal area hardly convex anteriorly in profile (Fig. 3A), medially slightly concave, with inconspicuous lateral ridge (Fig. 3B). Frontal pit distinct. Interantennal carinae rather sharp, becoming dull dorsally and ventrally, dorsally slightly curved medially and widely separated from each other (Fig. 3B), ventrally inconspicuous (Fig. 3C, D). Supraclypeal area swollen, medially rounded. Clypeus normally protruded anteriorly (= located anterior to area between eye and anterior tentorial pit), not widely flattened, smooth between small separated punctures. Malar space $0.7\text{--}0.8 \times$ width of median ocellus. Antenna normal (Fig. 1); in male, length $2.0\text{--}2.1 \times$ head width. Right mandible with notch on inner margin (Fig. 3D). In forewing (Fig. 1), cell 1Rs2 slightly widened apically, with anterior width $0.7\text{--}0.8 \times$ posterior width and apical length $0.7\text{--}0.8 \times$ posterior width; crossvein 2r-m very slightly sinuate; crossvein 3r-m slightly curved roundly. In both wings, margin between veins Rs and Cu glabrous, with marginal glabrous area narrower than width of vein M and marginal setae shorter than width of vein M (Fig. 3F). Dorsum of abdomen smooth, setose posteriorly and posterolaterally.

In female, seventh sternum normal. Each ovipositor sheath in posterodorsal view about as long as wide, with lateral margin gently rounded and apex narrowly rounded (Fig. 3G), in lateral view with apex rounded (Fig. 3H). Lance with some very narrow membranous areas midapically (Fig. 3I, J), apically roughly serrate on dorsal margin. Lancet (Fig. 4A) with about 22 serrulae (but apical serrulae inconspicuous), apically with narrow nonannulated area (naa); first annulus with row of setae (1cs) vestigial and annular plate (1ap) very small; second annulus with row

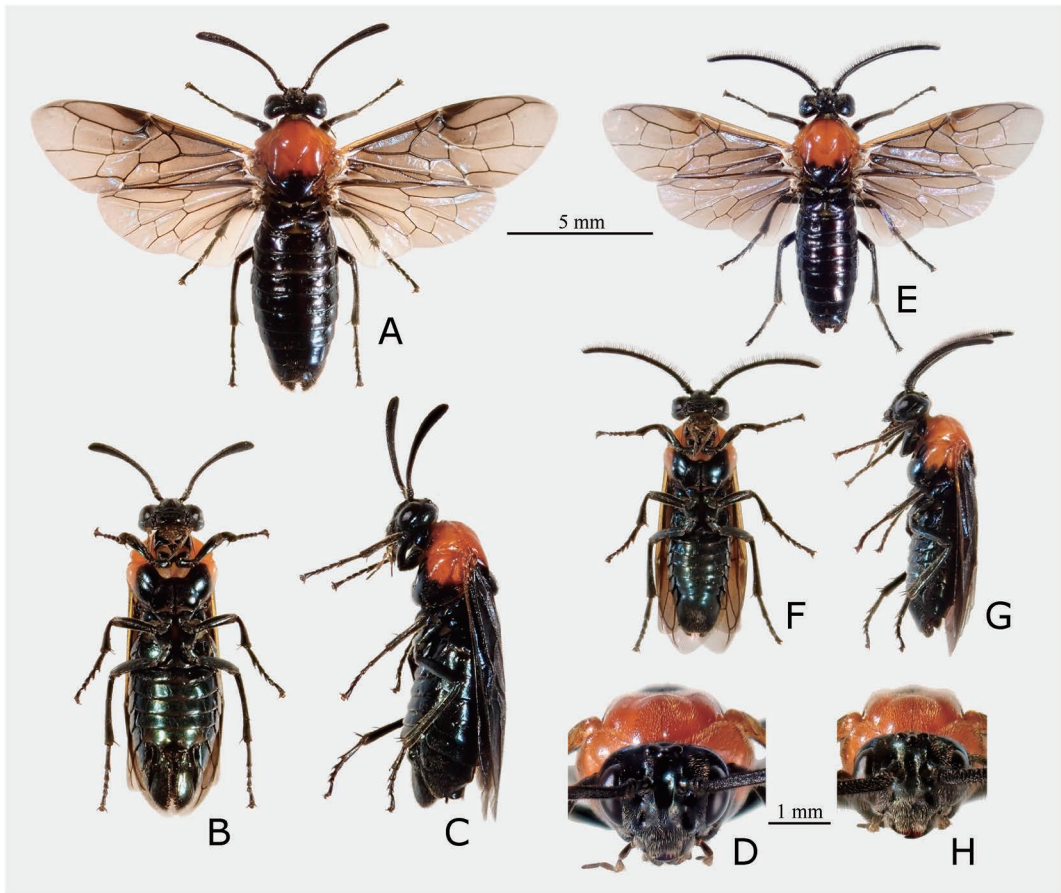


Fig. 1. *Arge ibukii*: A–D, Female, holotype; E–H, male, paratype, Nakagawa. A, E, Dorsal view; B, F, ventral view; C, G, lateral view; D, H, frontal view. Photographed just after killing.

of setae (2cs) well developed; transverse membranous areas between annular plates narrow; middle and apical annuli each straight, oblique, with dorsal end located posterior to ventral end; serrulae each triangular, with anterior slope shorter than posterior slope.

In male, subgenital plate in ventral view apically truncate or slightly concave (Fig. 1F). Genital capsule in ventral view with basiparamere apically narrowed and widely separated from the other, and harpe slightly wider than apical width of basiparamere and about $0.6\text{--}0.7\times$ as long as basiparamere (Fig. 5A, E); valviceps in dorsal view (Fig. 5C) apically bluntly pointed, laterally with short projection (lp) at apical third, in lateral view (Fig. 5D) apically bluntly pointed, ventrally

distinctly convex at middle, dorsally with large lobe (dl) between short apodemal projection (dap) and ergot (erg).

Immature stages. Male larva — First instar (Fig. 2G): Head black; trunk pale greyish green, with inconspicuous greyish spots; legs pale grey, with coxae darkened; suranal plate blackish. — Third instar (Fig. 2H) similar to first. — Fourth instar (semifinal instar) (Fig. 2I): Head dark brown; trunk pale green, with small dark spots; legs pale greyish yellow or pale green, with coxae blackish; abdomen slightly or distinctly darkened on second to eighth subspiracular lobes; suranal plate blackish. — Fifth instar (final instar) (Fig. 2J) similar to fourth in coloration, but head dark greenish brown and dark markings

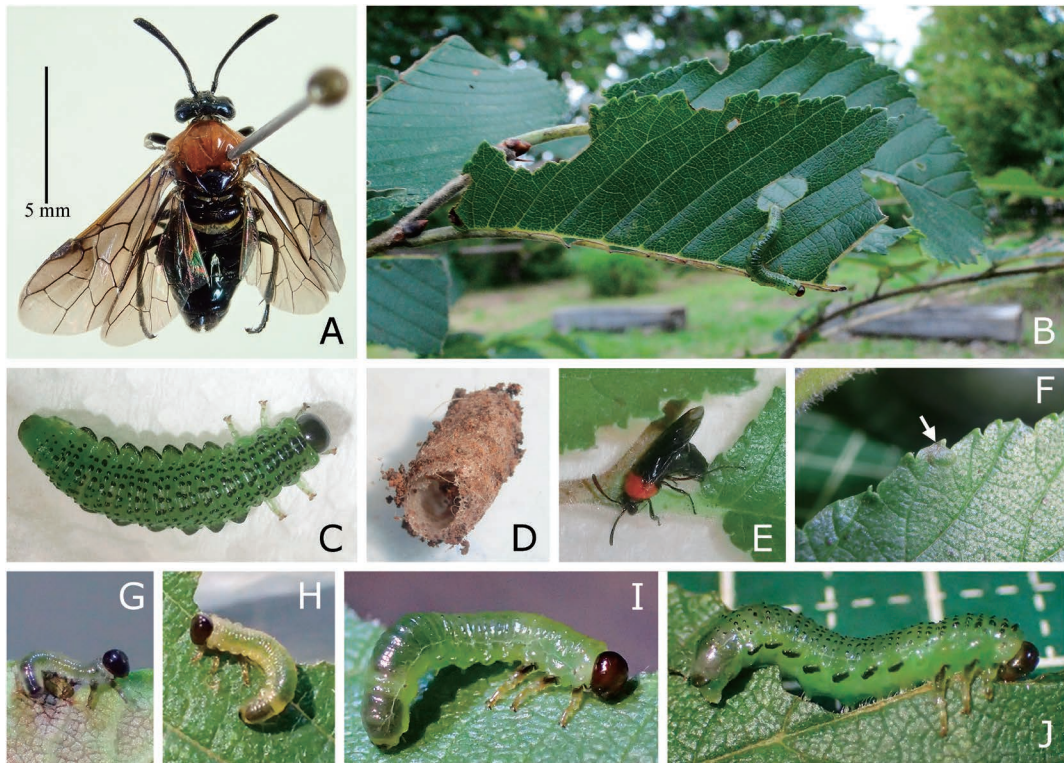


Fig. 2. *Arge ibukii*: A, Female, holotype; B, late instar larva discovered in the field, 28 June 2019; C, final instar larva, holotype, 3 July 2019; D, cocoon after emergence, holotype; E, female in oviposition, holotype, 24 July 2019; F, egg within leaf (arrowed) laid by holotype, 25 July 2019; G–J, male larvae, offspring of holotype; G, first instar, 1 August 2019; H, third instar, 6 August 2019; I, fourth (semifinal) instar, 10 August 2019; J, fifth (final) instar, 15 August 2019. B–J, Photographed by S. Ibuki. C–J, Photographed under rearing condition.

on trunk distinct; length 18 mm; antenna hemispherical, not flattened; clypeus with three pairs of setae; labrum with two pairs of setae; mandible with two setae on outer surface; first to ninth abdominal segments each three-annulated; proleg present on second to sixth and tenth abdominal segments; tenth proleg not extending posteriorly; tenth abdominal tergum in dorsal view widely rounded. Female final instar larva (Fig. 2C) as in male final instar larva in color, with larger dorsal black spots.

Cocoon (Fig. 2D): Length 11 mm in female, 10 mm in male; creamy, elongate oval, double walled; outer wall netted; inner wall parchment like.

Material examined. Holotype (Figs. 1A–D, 2A): ♀ labeled “PHH 190727A”, “JAPAN: Hon-

shu, Tochigi Pref., Nakagawa, Koisago, 36°46'N 140°8'E, coll. larva on *Ulmus davidiana* var. *japonica* 28. VI. 2019, mat. 3. VII., em. 23. VII. 2019, S. Ibuki”. Paratypes: 1 ♂, same data as holotype, but PHH 190723A, mat. 2. VII., em. 19. VII. 2019; 1 ♂, offspring of holotype, egg laid on *Ulmus davidiana* var. *japonica* 24. VII. 2019, hatched 1. VIII., larva mat. 16. VIII., em. 19. IX. 2019; 1 ♂, Japan: Honshu, Gunma Pref., Nishikurosawa, 790 m, 36-49-55N 138-57-29E, nr. Doai, 26. VIII. 2007, A. Shinohara, NSMTHYM 60627. Other material examined: 1 cocoon, with same data label as holotype, but mat. 2. VII.; 1 final instar larva, offspring of holotype, egg laid on *Ulmus davidiana* var. *japonica* 24. VII. 2019, hatched 1. VIII., mature larva fixed. 18. VIII. 2019.

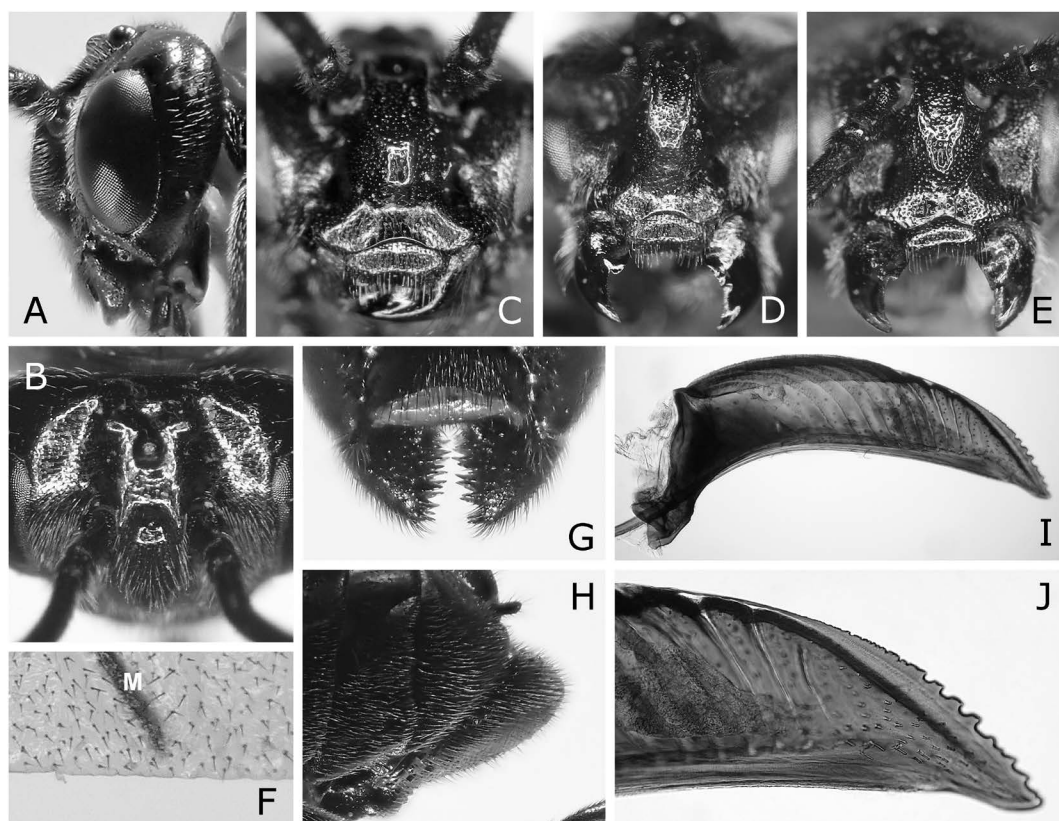


Fig. 3. A–C, F–J, *Arge ibukii*, female, holotype; D, *A. ibukii*, male, paratype, Nakagawa; E, *A. captiva*, female. A, Head, lateral view, B, head, anterodorsal view; C–E, ventral part of head, anteroventral view; F, apical margin of forewing (M = vein M); G, H, ovipositor sheath, posterodorsal and lateral views; I, J, lance, lateral view.

Distribution. Japan: Honshu.

Host plant. *Ulmus davidiana* Planch. var. *japonica* (Rehder) Nakai (Ulmaceae).

Field observations and rearing records. The first discovery was on June 29, 2018, when Ibuki found an almost mature larva walking on the leaf of *Ulmus davidiana* var. *japonica* in the garden of Iwamura Kazuo Ehon-no-oka Art Museum, Koisago, Nakagawa. The larva matured on June 30 and a parasitoid wasp emerged on September 15 of the same year. On June 28, 2019, Ibuki found three larvae on the same elm tree (Fig. 2B). Two smaller larvae matured and spun cocoons on July 2 and one larger larva did the same on July 3. One male adult emerged on July 19 from the cocoon made on July 2 and one female adult emerged on July 23 from the cocoon made on July 3, all in 2019. No adult

emerged from another cocoon spun on July 2.

On July 24, 2019, the female laid eggs along the margin of a leaf (Fig. 2E, F) and a total of 12 eggs hatched on August 1, 2019. Of the 12 young larvae, five were kept separately in individual containers and the remaining seven were reared together in a large container. Two of the five individually reared larvae reached maturity on August 16 after four molts (Table 1), whereas all the other ten larvae died by August 9. One male adult emerged on September 19, 2019.

The above observations suggest that *A. ibukii* has at least two or three generations a year. Under rearing conditions in July–August, the egg period is about seven days and the larval feeding period is about 15 days. The larva is solitary and rather cryptic, unlike the gregarious and conspicuous larva of *A. captiva*, and has five instars

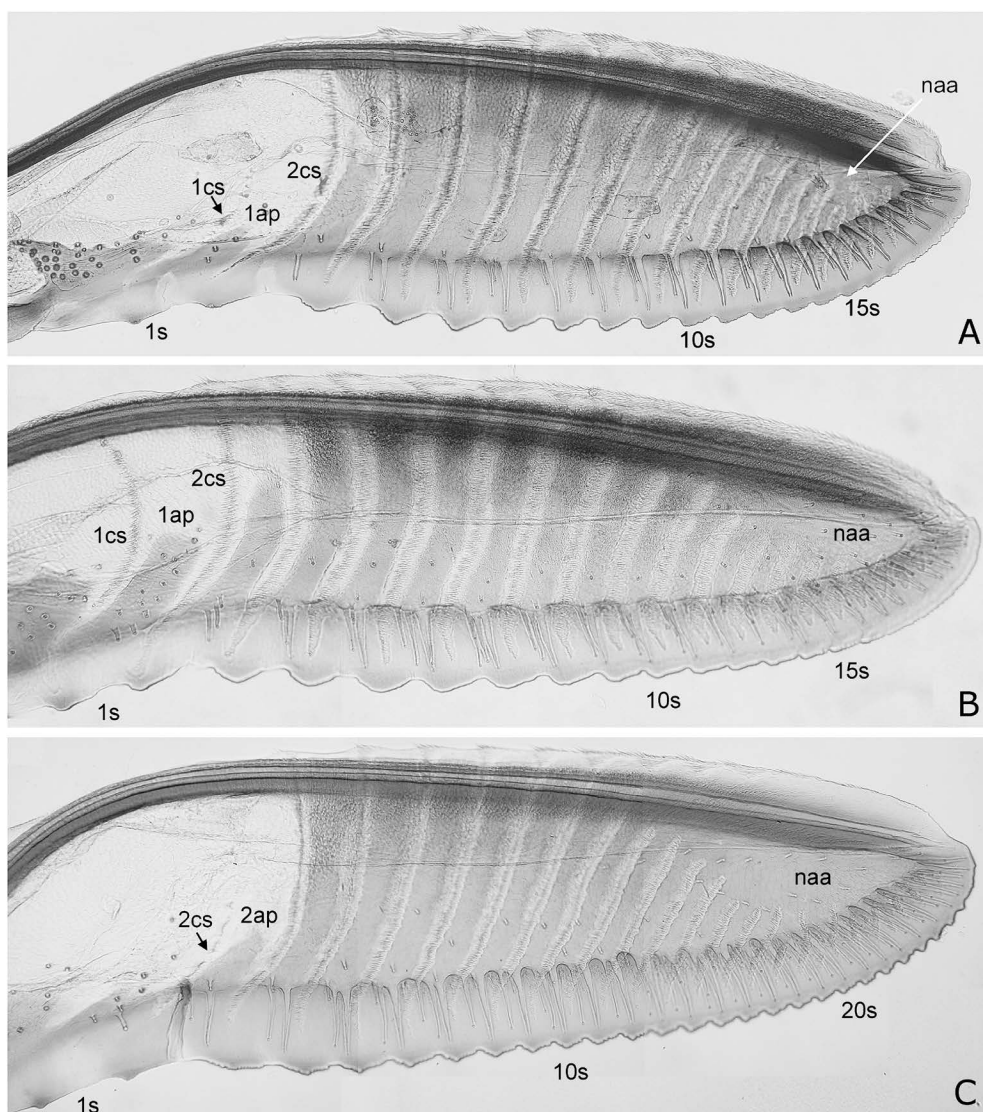


Fig. 4. Lancet. A, *Arge ibukii*, holotype; B, *A. captiva*; C, *A. watanabei*, holotype (reproduced with retouch from fig. 2A in Shinohara and Hara, 2010). Abbreviations: 1ap, 2ap = first, second annular plate; 1cs, 2cs = first, second ctenidial setae; 1s, 10s, 15s, 20s = first, tenth, fifteenth, twentieth serrula; naa = nonannulated area.

(four molts) in males. In one case in August–September, the adult male emerged 34 days after making a cocoon.

Remarks. *Arge ibukii* sp. nov. is a member of the *A. captiva* group, which includes *A. captiva* (Smith, 1874) from East Asia, *A. macrops* Shinohara, Hara and Kim, 2009, from the Russian Far East, Korea and China, *A. siamana* Togashi, 1988, from Thailand and *A. watanabei* Wei, Xiao

and Zhang, 1999, from China. They are bluish or purplish black sawflies usually with largely orange thorax (Fig. 1), entirely black legs, dark wings with slightly pale apex, supraclypeal area without a median carina (Fig. 3C–E), broad cell 2Rs in the forewing, which is not widened anteriorly and not or slightly widened apically (Fig. 1A, E), and glabrous or sparsely and slightly ciliate apical wing margins (Fig. 3F) (*cf.* Shinohara

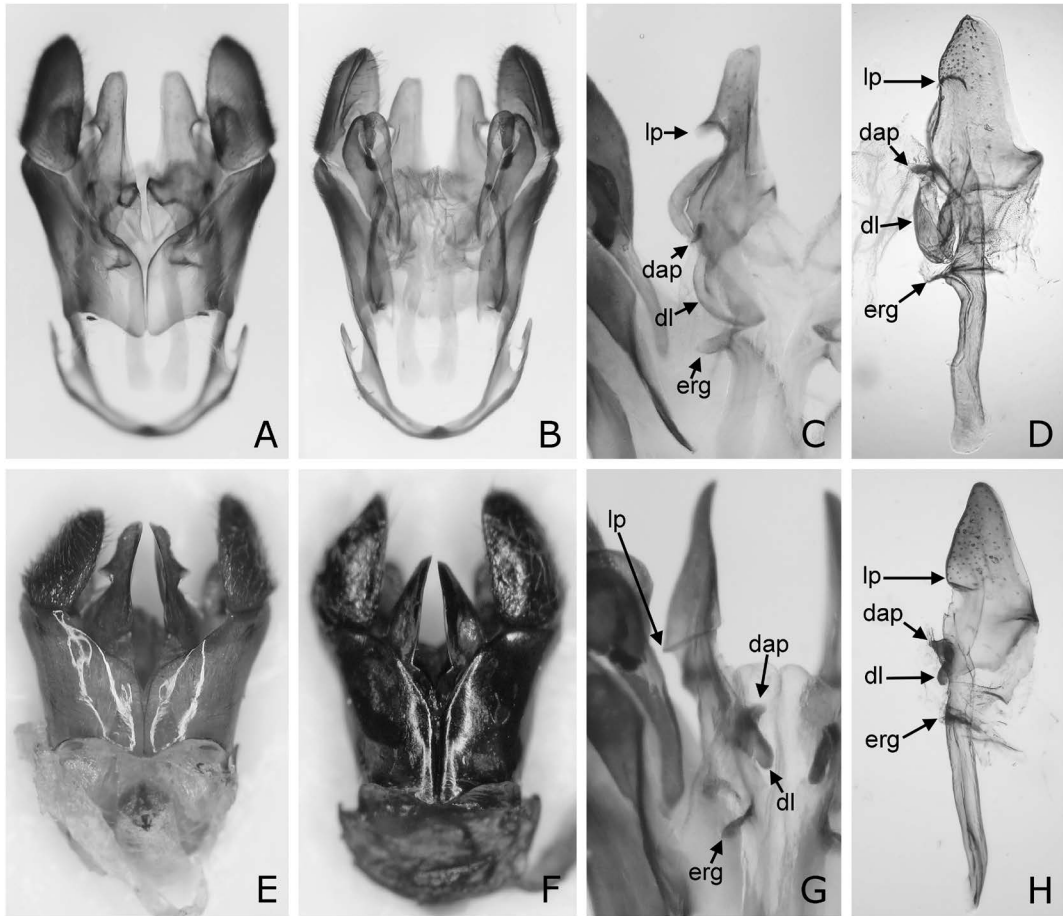


Fig. 5. Male genitalia. A–E, *Arge ibukii*, paratype (A–D, Nakagawa; E, Nishikurosawa); F–H, *A. captiva*. A, B, Genital capsule, ventral and dorsal views; C, G, valviceps, dorsal view; D, H, penis valve, lateral view (left dorsal); E, F, genital capsule of dry specimen. Abbreviations: dap = dorsal apodemal projection; dl = dorsal lobe; erg = ergot; lp = lateral projection.

Table 1. Rearing records of five larvae in 2019 (see text for explanation).

	hatched	molt 1	molt 2	molt 3	molt 4	matured	adult em.	remarks
1	Aug. 1	Aug. 4	Aug. 6					dead on Aug. 7
2	Aug. 1	Aug. 4						dead on Aug. 5
3	Aug. 1	Aug. 4	Aug. 6	Aug. 8	Aug. 11	Aug. 16	Sept. 19	
4	Aug. 1	Aug. 4	Aug. 6	Aug. 8	Aug. 11	Aug. 16		fixed on Aug. 18
5	Aug. 1	Aug. 4	Aug. 6					dead on Aug. 7

et al., 2009; Shinohara and Hara, 2010). *Arge ibukii* is distinguished from the latter four species in having yellow vein C of the forewing (Fig. 1A, E), normal eyes and ocelli (Fig. 3A, B), swollen supraclypeal area with rounded top (Fig. 3C, D), lancet with about 22 serrulae, inconspic-

uous apical serrulae, narrow membranous areas between annular plates and narrow apical nonannulated area (Fig. 4A), and valviceps basally with a large dorsal lobe (Fig. 5C, D).

The key to species of the *A. captiva* group given by Shinohara *et al.* (2009) is modified as

follows.

1. Eyes and ocelli exceptionally large and malar space very narrow (fig. 2A–C, N in Shinohara *et al.*, 2009). *A. macrops*
- Eyes, ocelli and malar space normal (Fig. 3A, B; fig. 2E–G, J–L, O in Shinohara *et al.*, 2009). ...2
2. Supraclypeal area medially with narrow V-shaped top flattened or very shallowly furrowed (Fig. 3E; fig. 2E, J, O in Shinohara *et al.*, 2009).3
- Supraclypeal area medially rounded (Fig. 3C, D; fig. 1A in Shinohara and Hara, 2010).4
3. Upper head with purplish reflection. Interantennal carinae except for ventral parts in supraclypeal area rather narrowly separated and distinctly convergent below (fig. 2E in Shinohara *et al.*, 2009). Supraclypeal area with side slopes very weakly rounded. Lancet with about 27 serrulae as recognized by number of marginal sensilla and serrulae conspicuous except for some serrulae at apical end (fig. 6A in Shinohara *et al.*, 2009). *A. siamana*
- Upper head with bluish reflection. Interantennal carinae except for ventral parts in supraclypeal area broadly separated and subparallel or very slightly convergent below (fig. 2J in Shinohara *et al.*, 2009). Supraclypeal area with side slopes roundly swollen. Lancet with about 22 serrulae as recognized by number of marginal sensilla and serrulae inconspicuous on wide apical part (Fig. 4B; figs. 6B–D, 7 in Shinohara *et al.*, 2009). *A. captiva* (most specimens)
4. Thorax black. Lancet with about 30 serrulae as recognized by number of marginal sensilla and serrulae conspicuous except for some serrulae at apical end (Fig. 4C; fig. 2A, B in Shinohara and Hara, 2010). *A. watanabei*
- Thorax mostly orange. Lancet with about 22 serrulae as recognized by number of marginal sensilla and serrulae inconspicuous on wide apical part (Fig. 4A, B).5
5. Vein C of forewing brown to black, rarely yellow. Lancet with row of ctenidial setae of first annulus (1cs) well developed (Fig. 4B; figs. 6B–D, 7 in Shinohara *et al.*, 2009); membranous areas between annular plates wide. Valvaceps with lateral projection (lp) located at apical third (usually concealed below basiparamere in dry specimens) and dorsally with inconspicuous or small lobe (dl) behind ergot (Fig. 5F–H; figs. 8D–F, 10 in Shinohara *et al.*, 2009). *A. captiva* (few specimens)
- Vein C of forewing yellow. Lancet with row of ctenidial setae of first annulus (1cs) vestigial (Fig. 4A); membranous areas between annular plates narrow. Valvaceps with lateral projection (lp) located near middle (well visible even in dry specimens) and dorsally with large lobe (dl) behind ergot (Fig. 5C–E). *A. ibukii*

In the key to Japanese species of *Arge* and *Spinarge* by Hara and Shinohara (2018), *A. ibukii* goes to the couplet 9 consisting of *A. captiva* and *A. rejecta* (Kirby, 1882), but it differs from *A. captiva* as stated above and from *A. rejecta* in having medially rounded supraclypeal area and almost glabrous apical wing margins.

Arge ibukii and *A. captiva* are the only species associated with *Ulmus* among Japanese Arginae. Their late instar larvae are distinguished as follows: *A. ibukii* (Fig. 2C, I, J) has a dark brown or dark greenish brown head, a pale green trunk,

and pale greenish yellow legs with blackish coxae, while *A. captiva* (fig. 11E, F in Shinohara *et al.*, 2009) has an almost pure black head, a creamy white trunk often with pale orange tint, and entirely black legs; black spots on the trunk of *A. ibukii* are smaller than those of *A. captiva*.

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