Bull. Natl. Mus. Nat. Sci., Ser. A, 47(2), pp. 99–105, May 21, 2021
DOI: 10.50826/bnmnszool.47.2-99

Life History and Larva of *Allomorpha hirasana* (Hymenoptera, Tenthredinidae) Feeding on *Symplocos* in Japan

Akihiko Shinohara[1], Shin-ichi Ibuki[2] and Hideho Hara[3]

[1]National Museum of Nature and Science,
4–1–1 Amakubo, Tsukuba, Ibaraki 305–0005, Japan
E-mail: shinohar@kahaku.go.jp
[2]Wami 1355–13, Nakagawa, Tochigi 324–0612, Japan
E-mail: banbi-fa@ktd.biglobe.ne.jp
[3]Nishi 4 Kita 3–4–29, Bibai, Hokkaido 072–0033, Japan
E-mail: harahideho@bell.ocn.ne.jp

(Received 8 February 2021; accepted 24 March 2021)

Abstract Based on rearing experiments in central Honshu, Japan, the previously unknown life history of *Allomorpha hirasana* Takeuchi, 1929, is outlined and the larva is briefly described and illustrated for the first time. This is a univoltine species with adult emergence in late April in rearing conditions. The egg period is 10–14 days and the larval period is about 28 days. The larva is a solitary external leaf feeder. The host plant association with *Symplocos* may support validity of the genus *Allomorpha*.

Key words: Allantinae, *Allomorpha*, life history, larva, *Symplocos*.

Introduction

Allomorpha hirasana Takeuchi, 1929, is an uncommon sawfly distributed in Honshu, Sado Island, Shikoku and Kyushu, Japan (Takeuchi, 1936, 1950). Okutani (1967) gave "*Palura Chinensis* KOIDZ, var. *leucocarpa* HARA" (= *Symplocos sawafutagi* Nagam. in current nomenclature, Yonekura and Kajita, 2021) as a host plant of *A. hirasana* with two asterisks, which meant that Okutani himself had "confirmed" the host relationship (p. 90 in Okutani, 1967). However, information about the life history and immature stages of this species has never been published.

In June 2019, Ibuki found an undetermined sawfly larva feeding on the leaf of *Symplocos sawafutagi* (Fig. 1) in Bato, Nakagawa Town, Tochigi Prefecture, central Honshu. By rearing this larva, Ibuki obtained a female adult (Figs. 2, 3A) in April 2020, which was identified as *A. hirasana*. This female deposited eggs on the host plant in a rearing cage and the larvae hatched from these eggs were reared until maturity (Fig. 3). Here we report on the life history of this species based on the observations of the rearing and give a short description of the larvae with photographs.

The generic placement of this species has differed by authors. It was originally described in the genus *Allomorpha* Cameron, 1876 (Takeuchi, 1929) but Takeuchi (1952) moved it to the genus *Taxonus* Hartig, 1837, because he placed *Allomorpha* in synonymy with *Taxonus* without giving any reasons. Some subsequent authors (Takeuchi, 1955; Okutani, 1967; Abe and Togashi, 1989; Togashi, 2000; Naito *et al.*, 2004; Yoshida, 2006; Naito, 2019, 2020) followed his treatment. On the other hand, Malaise (1963), Okutani (1970), Togashi (1972), Wei *et al.* (1997, 2011) and Taeger *et al.* (2010, 2018) treated *Allomorpha* as a valid genus, again without any discussion. Here we use the name *Allomorpha hirasana*, following the interpretation of the most recent world catalog (Taeger *et al.*, 2010, 2018). Though the validity of the genus *Allomorpha* and the generic

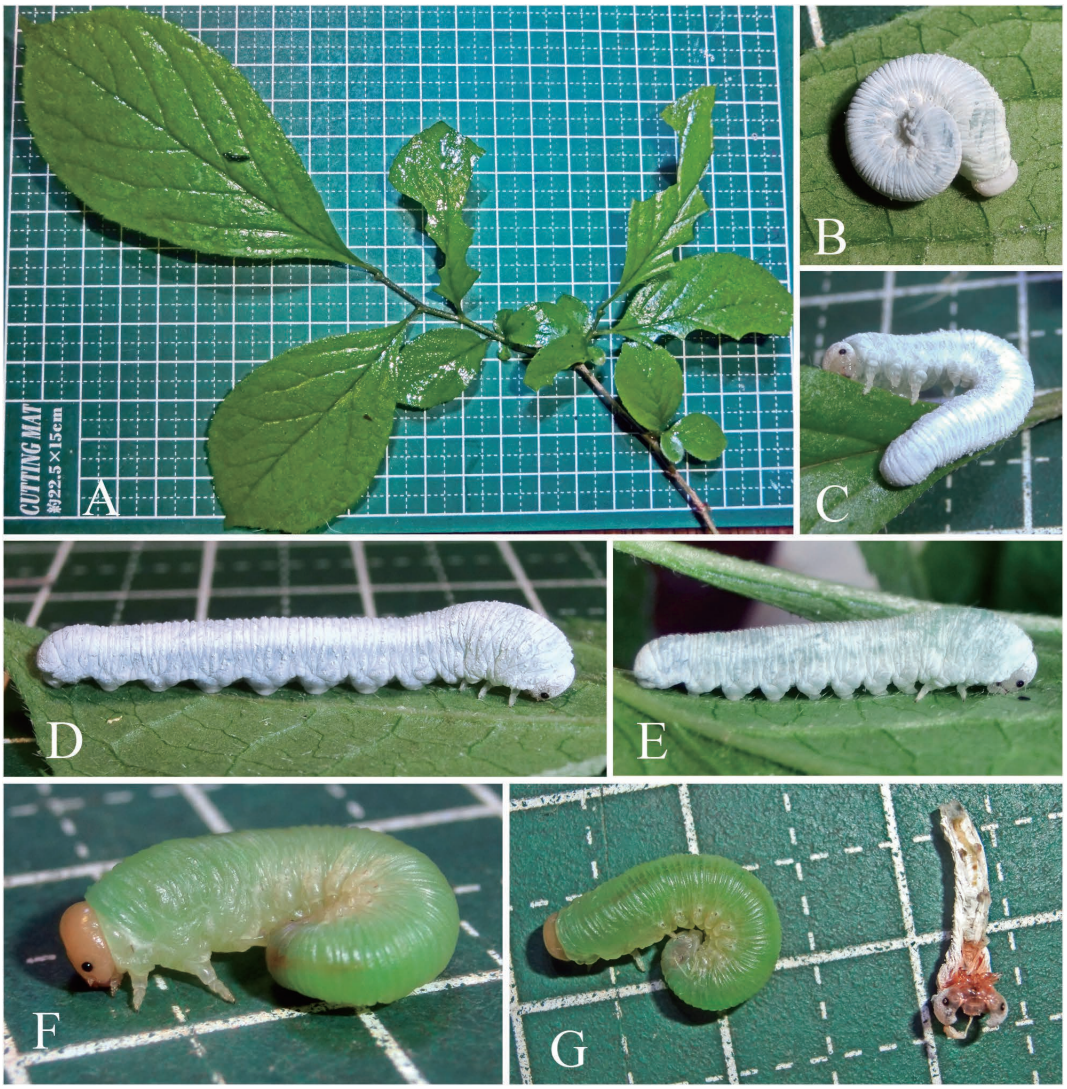

Fig. 1. *Allomorpha hirasana*, all photographed in Nakagawa, 2019. —A, Branch of *Symplocos sawafutagi* with leaves partly eaten by a larva of *A. hirasana*; B, female last feeding instar larva, June 11; C, same larva, June 15; D, same larva, June 16; E, same larva, shortly before molt, June 21; F, same larva, matured, just after molt, June 22; G, same larva and cast skin, June 22.

placement of *A. hirasana* should be accessed in the course of a revision of the "somewhat heterogeneous" (p. 42 in Takeuchi, 1952) genus *Taxonus* and its allies, we point out below that the different host plant association may support the validity of *Allomorpha.*

Materials and Methods

The female specimen obtained in this work is kept in the National Museum of Nature and Science, Tsukuba. Rearing was undertaken in a room at Bambi Farm in Wami (N36°47′ E140°10′, about 240 m alt.), Nakagawa Town, Tochigi Prefecture, Honshu. The temperature and day length were not controlled in the room, but the light was usually on for about 16 hours a day. Photographs were taken by Ibuki with digital cameras, Casio EX-ZR1000 S (Fig. 1) and Olympus Tough TG-4 (Fig. 3) and by Hara with an Olym-

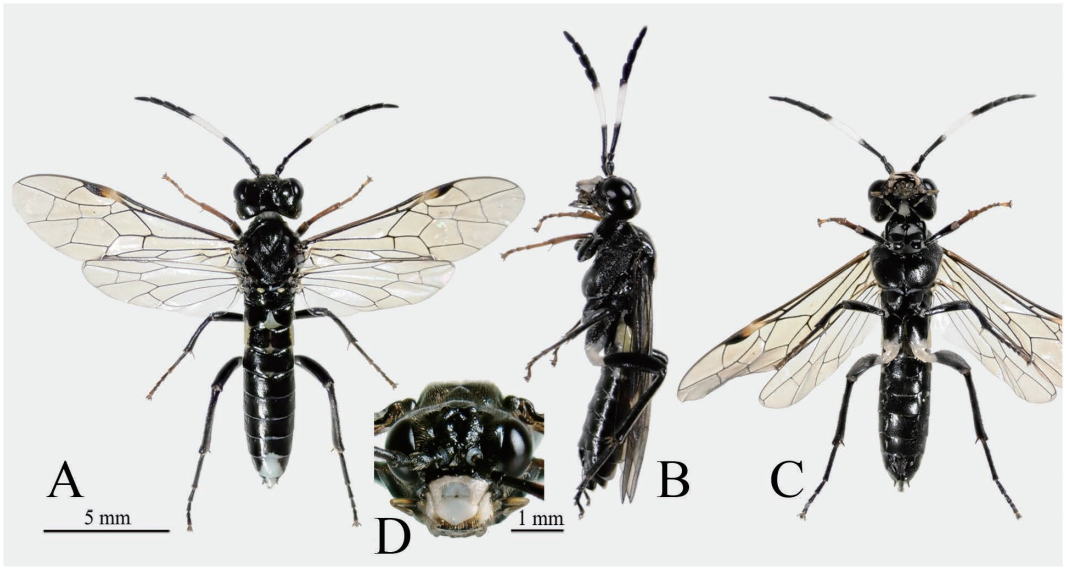

Fig. 2. *Allomorpha hirasana*, female adult. —A, Habitus, dorsal view; B, same, lateral view; C, same, ventral view; D, head, frontal view.

pus Tough TG-5 digital camera (Fig. 2). The digital images were processed and arranged with Adobe Photoshop Elements 9 and 12 and GIMP 2.10 software. We follow Yonekura and Kajita (2021) for plant names.

Results and Discussion

Allomorpha hirasana Takeuchi, 1929 (Figs. 1–3)

Host plant. Symplocaceae: *Symplocos sawafutagi* Nagam. (Okutani, 1967).

Field observations and rearing records. On June 10, 2019, one solitary larva (Fig. 1B–D) was found on the undersurface of a leaf of the host plant in Bato (N36°44′32.92″ E140°10′0.53″, 154 m), Nakagawa Town, Tochigi Prefecture. The larva was found on a leaf of a basal shoot of about 30 cm long on a stump near a stream in a rather dark deciduous forest with little sunshine. The larva had eaten the leaves from edge (Fig. 1A). It stopped feeding and moving on June 19, slightly shrank by June 21 (Fig. 1E) and cast skin (Fig. 1F–G) and entered the soil on June 22.

A female adult emerged on April 25, 2020 (Figs. 2, 3A). An earthen cell was found in the soil later (Fig. 3B). There was a cast skin of the prepupa in the cell (Fig. 3B). The female was kept in a container with a fresh branch of the host plant from April 25 to 29. Ovipositing behavior was not observed. On May 9, two very small larvae were found on the leaves used for the oviposition experiment (Fig. 3E). They were noticed because they had made small holes on the leaf by infestation (Fig. 3E). Because the consumed amount of the leaf was small and no cast skins were found, we regard the larvae as the first instar, which hatched probably on May 8. The two larvae were solitary, each found on a separate leaf, and each of the two leaves had a scar along the basal margin (Fig. 3C–D), which should be the exit of the larva from the egg inside of the leaf. One larva died on May 12. On May 17, the other larva molted (the first observed molt), thus becoming the second instar (Fig. 3F). On May 24, the larva molted, thus becoming the third instar (Fig. 3G). On May 26, the larva molted again, thus becoming the fourth instar (Fig. 3H–J), which was the last feeding stage. On June 5, the larva became a prepupa by casting the skin and went into the soil (Fig. 3K).

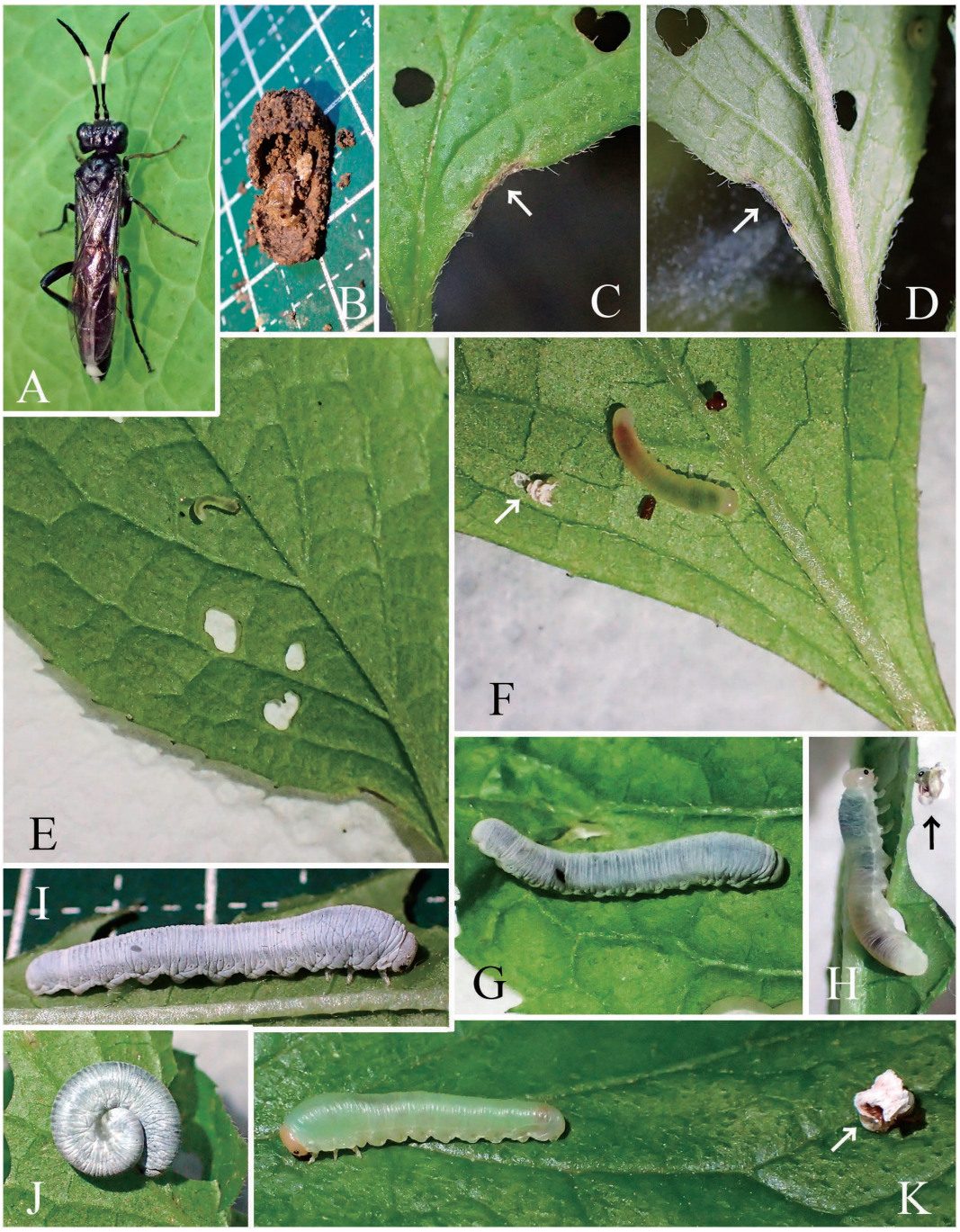

Fig. 3. *Allomorpha hirasana*, all photographed in Nakagawa, 2020. —A, Female adult, emerged on April 25 (same individual as in Fig. 2); B, earthen cell, half broken, with cast larval skin, April 26; C, basal part of leaf with remains of egg inside, an arrow showing exit of larva, May 10, upper surface; D, same, under surface; E, male first instar larva and three holes on a leaf made (eaten) by the larva, May 9; F, second instar larva, with cast larval skin (arrowed), May 17; G, third instar larva, May 25; H, fourth instar larva, just after third molt, with cast larval skin (arrowed), May 26; I, J, same larva, May 28; K, prepupa and cast larval skin (arrowed), June 5.

Larva. *First instar* (Fig. 3E): Head dark olive green. Trunk dull greenish white, cuticle opaque, without distinct white wax powder. *Second instar* (Fig. 3F): Head and trunk entirely dull greenish white, cuticle opaque, without distinct white wax powder. *Third instar* (Fig. 3G): Dull pale gray, wholly covered with white wax powder. *Fourth instar* (Fig. 3I–J): Length about 19 mm. Dull pale gray, wholly covered with white wax powder (no wax cover just after molt, Fig. 3H). *Mature larva* (*prepupa*) (Figs. 1F–G, 3K): Length about 14 mm. Head light beige; trunk light greenish white, cuticle smooth and shiny, without white waxy coating.

Earthen cell (Fig. 3B). Without fiber and rather easily broken with fingers; inside wall rather smooth.

Summary of life history. The above observations suggest that the general life history of *A. hirasana* in Bato area is as follows. There is one generation a year. The adult emerges in late April and inserts an egg into the leaf tissue along the outer margin of the basal part of leaf, one egg per leaf. The egg period is 10–14 days. The larva is a solitary external feeder. The first instar lasts about nine days, the second instar about seven days, the third instar about two days and the fourth instar about ten days. The early instar larva makes holes on the leaf by feeding (Fig. 3E), while the late instar larva feeds on the leaf from margin. The fourth instar larva, when matured, casts skin (extra molt) and becomes a prepupa and immediately enters the soil, where it makes an earthen cell. There the prepupa hibernates and becomes a pupa by casting the prepupal skin next spring.

The above summary is mainly based on the observations on the male individual. The larva shown in Fig. 1 is a female and the larva in Fig. 3 is a male. The latter hatched from an unfertilized egg deposited by the former female. The last feeding instar and prepupa (Figs. 1B–G, 3I–K) show no conspicuous sexual differences, whereas the early and middle instar larvae and the definite number of molts (instars) is still unknown for the female.

***Symplocos* as a host plant of sawflies and its possible implications in generic classification**. Larvae of sawflies utilize variety of plant groups as diets but, so far as we are aware, only two species of different genera of Tenthredinidae have been recorded as attached to *Symplocos*. One of them is *A. hirasana* (Okutani, 1967; present work) and the other is *Neocorymbas sinica* Wei and Ouyang, 1997, from Jiangxi, China (Wei *et al.*, 1997). Okutani (1967) listed *Symplocos sawafutagi* as a host plant of *A. hirasana*, as noted in the introduction, and Wei *et al.* (1997) simply noted "Host: *Symplocos paniculata* (Symplocaceae)" for *Neocorymbas sinica* without giving an explanation. These are the only available references to *Symplocos*-feeding sawflies and the immature stages and life history of these species were totally unknown.

The genus *Allomorpha* belongs to the subfamily Allantinae and is represented by five species from China besides *A. hirasana* from Japan (Taeger *et al.*, 2010). For the five Chinese species, host plants are unknown. Shinohara and Ibuki (2016) pointed out the occasional existence of close one-to-one host plant relationships between tenthredinid sawfly species groups/genera and plant genera/families. Examples are the tenthredininine genus *Conaspidia* Konow, 1898 with Araliaceae (the *sikkimensis* group with *Aralia* and the *scutellaris* group with *Kalopanax*) (Shinohara and Ibuki, 2011) and the allantinine genus *Emphytopsis* Wei and Nie, 1998 with *Stewartia* (Theaceae) (Shinohara *et al.*, 2014). As discussed in the introduction, some authors (Takeuchi, 1955; Okutani, 1967; Abe and Togashi, 1989; Togashi, 2000; Naito *et al.*, 2004; Yoshida, 2006; Naito, 2019, 2020) treated *Allomorpha* as a synonym of *Taxonus*, whose representatives are associated with Rosaceae (Okutani, 1967; Smith, 1979; Macek, 2010). The known exceptions are the Japanese species *T. fluvicornis* Matsumura, 1912 and *T. montanus* Togashi, 1992, which are attached to *Fallopia* and *Persicaria* (Polygonaceae), respectively (Okutani, 1959, 1967; Kato, 2018); the generic position of these two species may need revision. If the still unknown hosts of

the five Chinese species of *Allomorpha* are *Symplocos*, it will be a strong support for the validity of the genus *Allomorpha*. The other *Symplocos*-associated genus, *Neocorymbas*, belongs to the subfamily Tenthredininae, and this host association probably evolved quite independently.

Acknowledgements

We thank D. R. Smith (United States Department of Agriculture, Washington, D. C.) for his careful review of the manuscript.

References

Abe, M. and I. Togashi 1989. Symphyta. In Hirashima, Y. (ed.): A Check List of Japanese Insects, pp. 541–560. Entomological Laboratory Faculty of Agriculture, Kyushu University, Fukuoka (in Japanese).

Kato, Y. 2018. Discovery of host plant and larva of *Taxonus montanus* (Hymenoptera: Tenthredinidae) in central Honshu, Japan. Japanese Journal of Systematic Entomology 24: 264–266.

Macek, J. 2010. Taxonomy, distribution and biology of selected European *Dinax*, *Strongylogaster* and *Taxonus* species (Hymenoptera: Symphyta). Acta Entomologica Musei Nationalis Pragae 50(1): 253–271.

Malaise, R. 1963. Hymenoptera Tenthredinoidea, subfamily Selandriinae. Key to the genera of the world. Entomologisk Tidskrift 84: 159–215.

Naito, T. 2019. Subfamily Allantinae. In Editorial Committee of Catalogue of the Insects of Japan (ed.): Catalogue of the Insects of Japan, Volume 9 Hymenoptera (Part 1 Symphyta), pp. 47–57. Entomological Society of Japan, Kyoto (in Japanese).

Naito, T. 2020. Subfamily Allantinae, except genera *Monsoma*, *Empria* and *Emphytopsis*. In Naito, T., A. Shinohara, H. Hara and F. Ito: Sawflies and Woodwasps of Japan, pp. 104–111, 115–121, 376–385, 389–398. Hokkaido University Press, Sapporo (in Japanese).

Naito, T., H. Yoshida, H. Nakamine, T. Morita, T. Ikeda, H. Suzuki and A. Nakanishi 2004. Species diversity of sawflies in Hyogo Prefecture, central Japan. Museum of Nature and Human Activities, Hyogo, Monograph of Natural History and Environmental Science (1): 1–2 + pls. 1–10 + 1–85 (in Japanese).

Okutani, T. 1959. [Symphyta]. In Esaki, T., T. Ishii, A. Kawada, T. Shiraki and H. Yuasa (eds.): Illustrated Insect Larvae of Japan, pp. 548–582. Hokuryukan, Tokyo (in Japanese).

Okutani, T. 1967. Food-plants of Japanese Symphyta (II). Japanese Journal of Applied Entomology and Zoology 11: 90–99 (in Japanese with English abstract).

Okutani, T. 1970. Food-plants of Japanese Symphyta (III). Japanese Journal of Applied Entomology and Zoology 14: 25–28 (in Japanese with English abstract).

Shinohara, A. and S. Ibuki 2011. Host plants and larvae of two sawfly species, *Conaspidia singularis* and *C. hyalina* (Hymenoptera, Tenthredinidae), feeding on *Aralia* (Araliaceae) in Japan. Japanese Journal of Systematic Entomology 17(1): 83–90.

Shinohara, A. and S. Ibuki 2016. Host plant, larva and life history of *Asiemphytus fasciatus* (Hymenoptera: Tenthredinidae) in Japan. Bulletin of the National Museum of Nature and Science, Series A 42: 49–54.

Shinohara, A., T. Saito, S. Ibuki and H. Hara 2014. Sawflies of the genus *Emphytopsis* (Hymenoptera, Tenthredinidae) associated with *Stewartia* (Theaceae) in Japan. Zootaxa 3884: 301–318.

Smith, D. R. 1979. Nearctic sawflies. IV. Allantinae: Adults and larvae (Hymenoptera: Tenthredinidae). Technical Bulletin, U.S. Department of Agriculture No. 1595, 172 pp. + 24 plates.

Taeger, A., S. M. Blank and A. D. Liston 2010. World catalog of Symphyta (Hymenoptera). Zootaxa 2580: 1–1064.

Taeger, A., A. D. Liston, M. Prous, E. K. Groll, T. Gehroldt and S. M. Blank 2018. ECatSym—Electronic World Catalog of Symphyta (Insecta, Hymenoptera). Program version 5.0 (19 Dec 2018), data version 40 (23 Sep 2018).—Senckenberg Deutsches Entomologisches Institut (SDEI), Müncheberg. https://sdei.de/ecatsym/ (Last access: 30 January 2021).

Takeuchi, K. 1929. Descriptions of new sawflies from the Japanese Empire. Transactions of the Natural History Society of Formosa 19: 495–520.

Takeuchi, K. 1936. Some sawflies from Sado Island. Tenthredo 1: 150–164.

Takeuchi, K. 1950. *Allomorpha hirasana* Takeuchi. In Ishii, T., T. Esaki, S. Kinoshita, T. Shiraki, S. Uchida, T. Kawamura, S. Kuwayama and H. Yuasa (eds.): Iconographia Insectorum Japonicorum Editio Secunda Reformata, p. 1345. Hokuryûkan, Tokyo (in Japanese).

Takeuchi, K. 1952. A Generic Classification of the Japanese Tenthredinidae (Hymenoptera: Symphyta). 90 pp. Kyoto.

Takeuchi, K. 1955. Colored Illustrations of the Insects of Japan. Orthoptera, Odonata, Hemiptera, Neuroptera, Lepidoptera, Hymenoptera & Diptera. 190 pp. + 68 pls. Hoikusha, Osaka (in Japanese).

Togashi, I. 1972. Sawflies of Mt. Hiko, Kyushu (Hym., Symphyta). Mushi 46: 53–64.

Togashi, I. 2000. Japanese sawflies of the *japonicus* group of the genus *Taxonus* Hartig (Hymenoptera: Tenthredinidae). Proceedings of the Entomological Society of Washington 102: 313–321.

Wei, M., G. Ouyang and W. Huang 1997. A new genus

and eight new species of Tenthredinidae (Hymenoptera) from Jiangxi. Entomotaxonomia 19: 65–73 (in English with Chinese abstract).

Wei, M., Y. Xu and G. Niu 2011. Revision of *Emphytopsis* Wei & Nie (Hymenoptera: Tenthredinidae) with descriptions of seven new species from China and Japan. Zootaxa 2803: 1–20.

Yonekura, K. and T. Kajita 2021. BG Plants Wamei-Gakumei Index (YList). http://ylist.info/index.html (in Japanese; last access January 28, 2021).

Yoshida, H. 2006. Symphyta (Hymenoptera) of Osaka Prefecture, Japan. 24pls. + 128 pp. West Japan Hymenopterists' Club, Kakogawa (in Japanese).