

Larva and Life History of *Togashia horii* (Hymenoptera, Tenthredinidae) Feeding on *Cornus controversa* (Cornaceae) in Honshu, Japan

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Abstract Based on field observations and rearing experiments in Nagano and Niigata prefectures in central Honshu, Japan, we newly describe and illustrate immature stages of the tenthredinid sawfly *Togashia horii* (Togashi, 1962) and summarize current knowledge on its distribution and life history. The larvae of this species are well characterized by their conspicuous appearance, large size, gregarious feeding behavior and the wood-burrowing behavior on maturity.

Key words: Allantinae, gregarious larvae, life history, wood-burrowing behavior.

Introduction

Togashia horii (Togashi, 1962) is a large brownish allantine sawfly described from Honshu (Togashi, 1962) and later recorded from Shikoku (Seiyama and Tachikawa, 1983), Kyushu (Takakura, 1991) and Hokkaido (Naito, 2019, 2020). Togashi (1976) first recorded *Cornus controversa* Hemsl. var. *controversa* as a host plant of this sawfly and reported on its peculiar oviposition method and Seiyama and Tachikawa (1983) noted that they had obtained a female adult by rearing in Shikoku. However, these authors did not refer to the larval morphology and general life history of this species, which remained unknown.

In 2014 and 2015, Shinohara found several groups of large conspicuous sawfly larvae gregariously feeding on the leaves of *C. controversa* (Fig. 1A, B) in Tsugaike, Otari, Nagano prefecture. No attempt was made to rear them then and Shinohara was not able to identify the larvae with any certainty, though circumstantial evidence suggested that they belonged to *T. horii*. In

2022, Kojima found groups of similar looking larvae on *C. controversa* (Fig. 1C) in Sasagamine, Myoko, Niigata prefecture, and by rearing them succeeded in obtaining the adults, which were finally identified as *T. horii*. Here we report on this discovery and summarize the currently available information about the immature stages and biology of this species.

Materials and Methods

The adult specimens used in this work are kept in National Museum of Nature and Science, Tsukuba. Rearing experiments were performed by Kojima in Kitanagaike, Nagano city, Nagano prefecture, at an altitude of 335 m. The temperature and day length of the rearing room were not controlled, except that the highest temperature was set at 25°C. Photographs were taken with digital cameras: Ricoh Caplio GX100 (Fig. 1A, B, D, E) and Olympus Stylus TG-3 Tough (Figs. 1C, F, 2). The digital images were processed and arranged with Adobe Photoshop Elements 15 software. For the larval morphological terminology, we followed Viitasaari (2002).

Results and Discussion

Togashia horii (Togashi, 1962)

(Figs. 1, 2)

Taxonus horii Togashi, 1962: 203; Togashi, 1965: 251, pl. 126, 6; Togashi, 1976: 1; Seiyama and Tachikawa, 1983: 182; Murota and Kurokawa, 1985: 252; Tanaka *et al.*, 1985: 189; Togashi, 1988: 88; Abe and Togashi, 1989: 556; Takakura, 1991: 21; Togashi, 1992: 38; Haneda *et al.*, 1998: 320; Togashi, 1998: 262; Nakamura, 2003: 260; Nagase, 2004: 1252; Naito *et al.*, 2004: 41.

Togashia horii: Wei, 1997: 135; Taeger *et al.*, 2010: 305; Shinohara and Ibuki, 2016: 53; Nagase and Watanabe, 2018: 948; Yoshida, 2019; Naito, 2019: 57; Naito, 2020: 398, fig. 394.

[Undetermined sawfly larva]: Anonymous, 2008, 2020a, b.

Adult specimens examined. **Hokkaido:** 1 ♀ (fig. 394 in Naito, 2020), Kiyosato, Abashiri, 2. VII. 1998, H. Hara. **Niigata pref.:** 1 ♀, Arupuno-sato, 900 m, Yuzawa-machi, 30. VII. 2006, A. and N. Shinohara; 11 ♀ 4 ♂, Sasagamine, Myoko, 13. VII. 2018, A. Shinohara; 3 ♀ 3 ♂, same data but 18. VII. 2018; 3 ♂, Sasagamine, Myoko, larvae coll., 31.VIII. 2022, mat. 1. IX., em. 24. V. 2023, H. Kojima; 2 ♀ 11 ♂, same data but em. 25. V. 2023; 4 ♀ 5 ♂, same data but em. 30. V. 2023; 6 ♀ 4 ♂, same data but em. 3. VI. 2023. **Nagano pref.:** 1 ♀, Hakuba-jiri, 1200 m, Hakuba-mura, 12. VII. 2007, T. Naito; 1 ♀, Mt. Kasadake, 1700 m, Yamanouchi-machi, 4. VII. 2023, A. Shinohara.

Distribution. Japan: Hokkaido, Honshu, Shikoku, Kyushu. Collection records of this species are available from Hokkaido (Naito, 2020), Tochigi prefecture (Tanaka *et al.*, 1985), Kanagawa prefecture (Togashi, 1988; Nagase, 2004), Niigata prefecture (Togashi, 1992), Nagano prefecture (present work), Ishikawa prefecture (Togashi, 1962), Fukui prefecture (Murota and Kurokawa, 1985; Togashi, 1992; Haneda *et al.*, 1998), Hyogo prefecture (Naito *et al.*, 2004), Ehime prefecture (Seiyama and Tachikawa, 1983) and Oita prefecture (Takakura, 1991). On the internet, photographs of the characteristic larvae of *T. horii* are available from Yamagata prefecture (Anonymous, 2008),

Nagano prefecture (Anonymous, 2020a) and Kumamoto prefecture (Anonymous, 2020b). As shown above, we have examined adult specimens only from Hokkaido, Niigata prefecture and Nagano prefecture. As far as we are aware, *T. horii* has only been recorded from Japan.

Host plant. Cornaceae: *Cornus controversa* Hemsl. var. *controversa*.

Field observations and rearing records. On September 14, 2014, Shinohara encountered several groups of large gregarious sawfly larvae infesting the leaves of *Cornus controversa* (Fig. 1A, B) in Tsugaikae at an altitude of about 1800 meters, Otari, Nagano prefecture. The feeding of those larvae apparently caused much damage to the *Cornus* trees in the area (Fig. 1D). No attempt was made to rear them. In mid-September, 2015, Shinohara also observed a larva of probably the same species trying to enter a dead branch (about 2 meters above the ground) of a tree at the same locality. This behavior of the mature larva suggested that the larva probably belonged to the subfamily Allantinae and was presumably *Togashia horii* because of its large size and the habitat having natural environmental conditions probably similar to those of the type locality. However, the larva was left undetermined due to lack of clear evidence.

On August 31, 2022, Kojima found two groups of gregarious larvae feeding on *C. controversa* in Sasagamine at an altitude of about 1300 meters, Myoko, Niigata prefecture. The larvae were brought into a rearing room in Nagano city, where the larvae of one group matured on September 1 and a total of 35 adults emerged from May 24 to June 3, 2023. The males tended to emerge earlier than the females, as shown above in the list of specimens examined. The larvae of another group matured and entered a dead branch of a tree on September 9 (Fig. 1F).

Three females that emerged on June 1 and 3, 2023, were put in a plastic container with twigs of *C. controversa* and they oviposited on June 2–3 and 12–13. The eggs deposited on June 12–13 (Fig. 2B–E) hatched on June 24–25 (Fig. 2G–I) but all the larvae died for unknown rea-



Fig. 1. *Togashia horii*, late instar larvae (A–C), damage of host leaves (D), eaten leaf with larval exuviae (E) and mature larvae entering dead branch (F). A, B, D, E, Tsugaike, September 14, 2014; C, Sasagamine, August 31, 2022; F, Nagano, September 9, 2022. Photographed by Shinohara (A, B, D, E) and Kojima (C, F).

sons by June 29.

Life history. According to our observations on the mountains in Nagano prefecture and Niigata prefecture, the rearing records and the adult collection records examined (see above), the adults were active in July and the larval feeding period was in August to September. In the rearing room in Nagano city, the adults emerged at the end of May to June. At least in the areas studied or in the areas with similar climatic conditions, this species apparently has only one generation a

year.

Seiyama and Tachikawa (1983) mentioned “One female emerged on April 30, 1974 in rearing” (original in Japanese) in Komenono, Ehime prefecture. Unfortunately, no more data about the rearing, including the discovery date of the larvae, were published. Naito (2020) stated “Thought to be multivoltine, with adult emergence from spring to autumn” (original in Japanese) without showing evidence or references. Presumably, his statement was based on the pub-

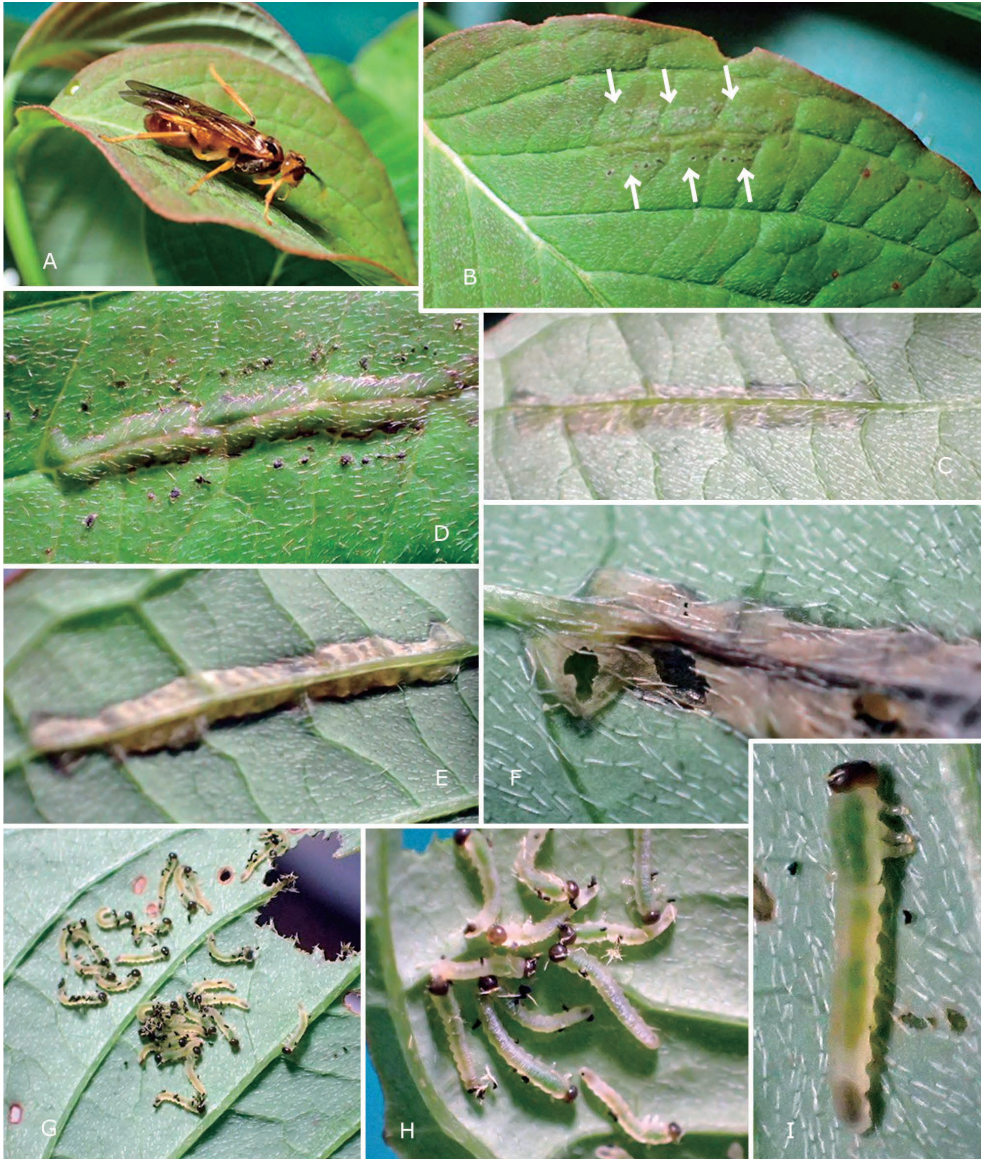


Fig. 2. *Togashia horii*, female adult (A), host leaf with eggs deposited inside (B–E) host leaf with larval exit holes (F) and early instar larvae (G–I). A, June 12; B, upper surface, arrows showing rows of eggs inside, June 14; C, same leaf, underside, June 14; D, same leaf, upper surface, showing inflated eggs inside, June 18; E, same leaf, underside, June 18; F–H, June 26; I, June 28. All photographed indoors in Nagano by Kojima in 2023.

lished collection records of the adults in Hyogo prefecture, where the adults were collected in April, July and September according to Naito *et al.* (2004). Multivoltinism of this species in warmer regions should be confirmed by further studies.

Eggs and oviposition. The eggs are laid in long

rows along the leaf veins (Fig. 2B–E; figures 2 and 3 in Togashi, 1976). Togashi (1976) noted that “The eggs are laid into the spongy mesophyll tissues of the leaf through the upper epidermis, making slits approximately 0.3 mm long along the leaf vein (Fig. 3A)” and “They hatch in about 10 days”. We have observed that the freshly

deposited eggs were not conspicuous (Fig. 2B, C) but they became inflated and easily recognizable (Fig. 2D, E) after several days. In our rearing records, the egg period was 11–13 days.

Larvae. Early instar (Fig. 2G–I): head brown to black; trunk translucent creamy white. *Late instar* (Fig. 1A–C): head black covered with thin whitish wax powder layer; trunk dark yellow in ventral half (spiracles and below), black broad longitudinal line just above spiracles through supraspiracular and laterodorsal regions, and dorsal surface above these black lines gray with thick white wax layer; thoracic legs brownish. Just after molt, head orange and dorsal surface without wax layer (Fig. 1C, left). *Mature larva* (Fig. 1F): similar to late feeding instar, but dorsal surface without white wax layer and slightly tinted with blue.

The late-instar larvae form a large group usually on the lower surface of a leaf, often occupying almost entire lower surface (Fig. 1A). The cast skins of the larvae are left on the margins near the base of a leaf and on the stem (Fig. 1E). The larvae often consume the *Cornus* leaves nearly completely, apart from the midrib (Fig. 1D, E). On maturity, the larvae go into dead branches or wood (Fig. 1F) and stay inside until emergence as adults.

Comparison with other sawfly larvae. The older larvae of this species are distinctive in their striking color pattern and large size, and all larval instars in their gregarious feeding behavior (Figs. 1A–C, 2G, H). The mature larvae enter dead branches or wood (Fig. 1F). These characteristics make *T. horii* larvae easily distinguishable from other sawfly larvae in Japan. The unidentified larvae shown on the internet (Anonymous, 2008, 2020a, b) most probably belong to *T. horii*.

Two Japanese species of sawflies other than *T. horii* are known to be associated with *Cornus*, a Pamphiliidae, *Pamphilius japonicus* Shinohara, 1985 (Shinohara *et al.*, 2019) and a Tenthredinidae, *Asiemphytus fasciatus* Takeuchi, 1929 (Shinohara and Ibuki, 2016). The larva of *P. japonicus* is a solitary leaf-roller readily recognized by its distinctive pamphiliid features (Shinohara *et al.*,

2019). *Asiemphytus fasciatus* belongs to the same subfamily Allantinae as *T. horii*. The larvae of the two species resemble each other in general morphology, and also the wood-burrowing behavior of mature larvae, but they differ greatly in coloration and feeding behavior. The late instar larvae of *A. fasciatus* have mainly creamy white to pale gray trunk with dorsolateral rows of black dots and they are solitary, not gregarious, feeders (Shinohara and Ibuki, 2016).

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