

Host Plants and Larvae of Two Sawfly Species of the *Pamphilius sylvaticus* Group (Hymenoptera, Pamphiliidae) in Japan

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Abstract Based on field observations and rearings from 2007 through 2010, mainly in Nagano Prefecture, central Honshu, Japan, host plants are newly recorded for two rare pamphiliid sawflies belonging to the *Pamphilius sylvaticus* group. The larva of *Pamphilius daisenus* Takeuchi, 1938, is a solitary leaf-roller on *Aruncus dioicus* (Walter) Fernald var. *kamtschaticus* (Maxim.) H. Hara (Rosaceae), and the larva of *P. montanus montanus* Shinohara, 1985, is a gregarious web-spinner on *Sorbus commixta* Hedl. (Rosaceae). Brief descriptions of the larvae and notes on the life history of the two species are given.

Key words: Hymenoptera, Pamphiliidae, *Pamphilius daisenus*, *Pamphilius montanus montanus*, larvae, *Aruncus*, *Sorbus*, life history.

The *Pamphilius sylvaticus* group is one of the major species-groups in the sawfly genus *Pamphilius* Latreille, 1802 (Shinohara, 2002). Known larvae of the component species are solitary or gregarious leaf-rollers or web-spinners on Rosaceae, Betulaceae or Cornaceae. Of the 23 World species, host plants are known for three European, three North American and four Japanese species (Shinohara, 2002). In Japan, host records are available for *P. alnicola* Ermolenko, 1973 (on *Alnus*, Shinohara and Hara, 1993), *P. benesi* Shinohara, 1985 (on *Corylus*, Shinohara and Hara, 1997), *P. gracilis* Shinohara, 1985 (on *Sorbus*, Shinohara and Hara, 1992), and *P. volatilis* (Smith, 1874) (on *Cerasus* and *Crataegus*, Shinohara and Hara, 1999). For the remaining three species from Japan, *P. daisenus* Takeuchi, 1938, *P. japonicus* Shinohara, 1985, and *P. montanus montanus* Shinohara, 1985 (with two subspecies, *P. montanus montanus* and *P. montanus pulcher* Shinohara, 1988), host plants and immature stages have been unknown.

Here, we give new host records for two rare species and subspecies, *P. daisenus* and *P. mon-*

tanus montanus, based on field observations and rearing experiments mainly conducted in Nagano Prefecture, central Honshu, Japan, in 2007–2010. Notes on the life history and the immature stages are also given. The larvae of *P. daisenus* are solitary leaf-rollers on *Aruncus* (Rosaceae), and those of *P. montanus montanus* are gregarious web-spinners on *Sorbus* (Rosaceae). This is the first record of *Aruncus* as a host plant for pamphiliid sawflies.

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Materials and Methods

Observations and collections were made in various localities in Nagano, Niigata, and Gunma Prefectures in central Honshu, Japan. The rearing was conducted by Kojima in Kitanagaike, Nagano City, Nagano Prefecture, at an altitude of 335 m, except for one which was made by Shinohara in Kuramae, Tokyo Metropolis, at an altitude of 2 m, as noted below. In order to count the

number of molts during the larval stage, each leaf-roll was examined every day and cast skins were collected when present for the larva of *P. daisenus*, a solitary leaf-roller, whereas each abandoned nest was examined and cast skins were collected for the larva of *P. montanus montanus*, a gregarious web-spinner. On maturity, each larva was placed in an individual jar containing ordinary untreated soil. The temperature of the rearing room was not controlled, except that the highest temperature was set at 25°C.

The reared adult specimens are deposited in the National Museum of Nature and Science, Tokyo. For the scientific names of the host plants and larval morphological terminology, we follow Yonekura and Kajita (2010) and Viitasaari (2002a, b), respectively.

Results and Discussion

Pamphilius daisenus Takeuchi, 1938

(Fig. 1A–H, Table 1)

Host plant. Rosaceae: *Aruncus dioicus* (Walter) Fernald var. *kamtschaticus* (Maxim.) H. Hara. New record.

Field observations and rearing records. A) On August 20, 2007, Shinohara found a pamphiliid larval abode on a leaf of *Aruncus dioicus* var. *kamtschaticus* in Shiga-kogen (about 1650 m), Nagano Prefecture, Honshu. No larva was found inside.

B) On September 1, 2008, Shinohara found a similar leaf-roll on the same plant species in Tsugaike-kogen (about 1570 m), Nagano Prefecture, but the abode was again empty.

C) On August 4, 2009, Shinohara found two pamphiliid eggs, one each deposited on the un-

dersurface of a leaflet of the same plant species, along a car road near Mt. Kasa-dake (about 1680 m), Nagano Prefecture, and reared them in Tokyo. The eggs hatched on August 7, and the larvae reached maturity on August 23 and 25, respectively, but no adults emerged in 2010.

D) At the same site, Kojima found three leaf-rolls, one each on the underside of a leaflet of *Aruncus* on August 12, 2009. Two of these were empty but one contained a larva, which was reared in Nagano City. It molted on August 14 and matured and entered the soil on August 18. One female emerged on May 26, 2010 (Fig. 1C). The female was kept alive in a cage with fresh leaves of *Aruncus* from May 27 to its death on June 3. The sawfly laid 12 eggs on June 1 and five eggs on June 2.

The 17 eggs hatched on June 8–9 and 15 larvae, after molting four or five times, matured on June 21–25. Table 1 summarizes details of their development.

E) On August 20, 2009, Kojima found one leaf-roll containing a larva on *Aruncus* near Mt. Kasa-dake (about 1760 m), Nagano Prefecture (Fig. 1A) and reared it in Nagano City. It molted on August 23 and 26 and matured on August 31. No adult emerged in 2010.

F) On July 25, 2010, Kojima found one leaf-roll containing a larva on *Aruncus* in Tsubame-onsen (about 1030 m), Niigata Prefecture, and reared it in Nagano City. It matured and entered the soil on the same day.

G) On August 13, 2010, Kojima and Shinohara found two leaf-rolls on *Aruncus*, one at Shimizu-koen (about 1590 m) and the other at Mt. Asahi-yama (about 1690 m), both in Shiga-kogen, Nagano Prefecture. Kojima reared them in Nagano City. The one from Shimizu-koen ma-

Fig. 1. *Pamphilius daisenus* (A–H) and *P. montanus montanus* (I–J).—A, Larval leaf-roll on *Aruncus* (arrowed), Mt. Kasa-dake, photographed on August 20, 2009; B, do., remains of egg shell arrowed, photographed on June 11, 2010; C, adult female, reared from larva collected on Mt. Kasa-dake, photographed on May 28, 2010; D, egg and hatching larva, photographed on June 9, 2010; E, 1st instar larva, photographed on June 9, 2010; F, 3rd instar larva, 9.5 mm long, photographed on June 17, 2010; G, last instar larva, 20 mm long, photographed on August 14, 2009; H, do., mature larva, 18 mm long, photographed on August 18, 2009; I, larval nest on *Sorbus*, photographed at Yumi-ike on August 24, 2007; J, last instar larvae, photographed on July 29, 2009. All photographs taken by H. Kojima.

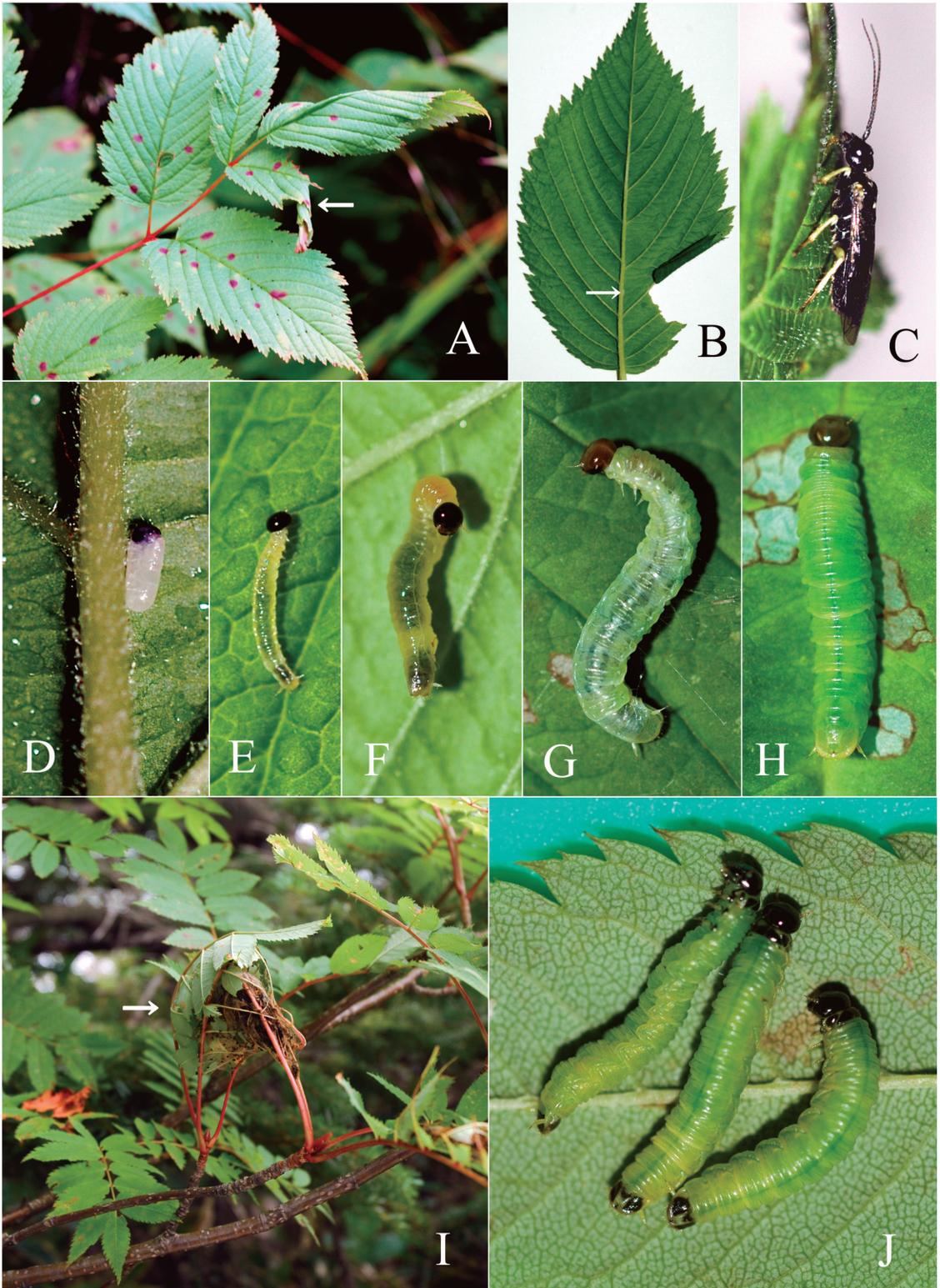


Table 1. Duration of egg and feeding larval periods (days), number of instars, and lengths of mature larvae of 17 male individuals of *P. daisenus* (see text for more explanation).

Individual code*	Egg	Larva, instars I–VI, and total							Number of instars	Length of mature larva (in mm)	Remarks
		I	II	III	IV	V	VI	total			
A1	7	3	2	1	2	3	5	16	6	15	
A2	7	3	2+								dead in 2nd instar
A3	7	3	2	4	3	6		18	5	13	
A4	7	3	2	3	4	4		16	5	14	
A5	7	3	2	2	3	5		15	5	14	
A6	7	3	2	2	2	3	4	16	6	15	
A7	7	3	2+								dead in 2nd instar
A8	7	3	2	3	4	4		16	5	14	
A9	7	3	2	2	4	5		16	5	14	
A10	7	3	2	3	3	5		16	5	14	
A11	7	3	2	3	1	3	6	18	6	14	
A12	7	3	2	4	3	6		18	5	15	
B1	7	2	2	2	4	4		14	5	14	
B2	7	2	2	2	4	4		14	5	15	
B3	7	2	2	2	3	4		13	5	14	
B4	7	2	2	1	3	3	6	17	6	17	
B5	7	2	2	2	4	4		14	5	15	

* Eggs laid on June 1 (A1–12) and June 2 (B1–5), 2010.

tured on August 17 and the one from Mt. Asahi-yama molted on August 17 and matured on August 23.

H) On August 22, 2010, Kojima found three leaf-rolls on Mt. Ikenoto-yama (about 2150 m), Gunma Prefecture; two of these contained a larva each, while one was empty. Kojima reared the two larvae in Nagano City. Both of them matured and entered the soil on August 24.

Larvae. First instar (Fig. 1E): Head black; antenna, trunk and its appendages whitish. Last instar: feeding stage (Fig. 1G) 13–19 mm, mature larva (Fig. 1H) 13–17 mm (Table 1); head dark brown, more blackish laterally and on frons, greenish along epicranial suture; antennal segments dark brown, whitish basally and apically; mandibles blackish brown; trunk pale green; cervical sclerite blackish; prothoracic shield pale olive green; thoracic legs and subanal appendage whitish; suranal hook blackish; posterior margin of caudal segment pale yellowish.

Notes on life history. *Pamphilius daisenus* is a rare species distributed in Japan (Honshu) and Korea (Takeuchi, 1938; Shinohara, 2001). It has

probably one generation a year as in its congeners. In Honshu, adults were collected mainly at higher altitudes (300–2000 m) in Aomori, Miyagi, Saitama, Nagano, Gifu, and Tottori Prefectures in June to August (Shinohara, 1985, 1988, 2001). In this study, one adult emerged in late May under experimental conditions in Nagano City (335 m), but the adults actually occurred in late July or early August at higher places such as Mt. Kasa-dake (about 1680–1760 m), Shimizu-koen (about 1590 m), Mt. Asahi-yama (about 1690 m) and Mt. Ikenoto-yama (about 2150 m) and in early July in Tsubame-onsen (about 1030 m), because the eggs or larvae were found in August at the former four localities and in late July at the latter locality, which is lower than the former four.

The eggs were laid on the underside of a leaflet, along the midvein (15 of 20 cases observed, Fig. 1B, D) or near the junction of the lateral vein from the midvein (five cases). In all cases observed, the eggs were deposited in the basal half of the leaflet. Usually only one egg was deposited on one leaflet (Fig. 1B), whereas

in one case the female deposited three eggs on one leaflet in captivity. Of the 18 cases, nine eggs were on the terminal leaflets and nine were on the lateral leaflets (unrecorded in the remaining two cases). The larval leaf-rolls were always on the underside of the leaflet and the larvae were solitary. Table 1 shows the development of 17 eggs laid by a female reared from a larva collected in the field (see rearing D above). The eggs were all unfertilized and thus all males. Duration of the egg stage was seven days in all cases and that of the larval stage was 13–18 days. The larvae, all males, had four or five molts before reaching maturity; the reason for this individual difference is unknown.

Comparative comments. The larva of *P. daisenus* is a solitary leaf-roller of *Aruncus dioicus* var. *kamtschaticus*. This is the only pamphiliid sawfly known to feed on *Aruncus*. The mature larva is characterized by the brown head and the almost entirely pale green trunk, except for the blackish cervical sclerite and suranal hook. It resembles the larvae of *P. gracilis* Shinohara, 1985, on *Sorbus*, *P. hortorum* (Klug, 1808)

on *Rubus*, and *P. tricolor* Beněš, 1974, on *Salix* among the Japanese congeners (Shinohara and Hara, 2005, 2009; Shinohara and Kojima, 2009) and *P. gyllenhali* on *Salix* from Europe (Lorenz and Kraus, 1957; Viitasaari, 2002b). However, the larvae of these four species differ from the larva of *P. daisenus* in having a pale-colored cervical sclerite.

Pamphilius montanus montanus Shinohara,
1985

(Figs. 1I–J, 2)

Host plant. Rosaceae: *Sorbus commixta* Hedl.
New record.

Field observations and rearing records. A) On August 24, 2007, Kojima found a pamphiliid web nest containing a group of pamphiliid larvae gregariously feeding on the leaves of *Sorbus commixta* at Yumi-ike (2030 m) on Mt. Shiranesan, Gunma Prefecture. Six larvae matured on August 26, but only parasitic wasps emerged in next spring. The nest was made by silk combin-

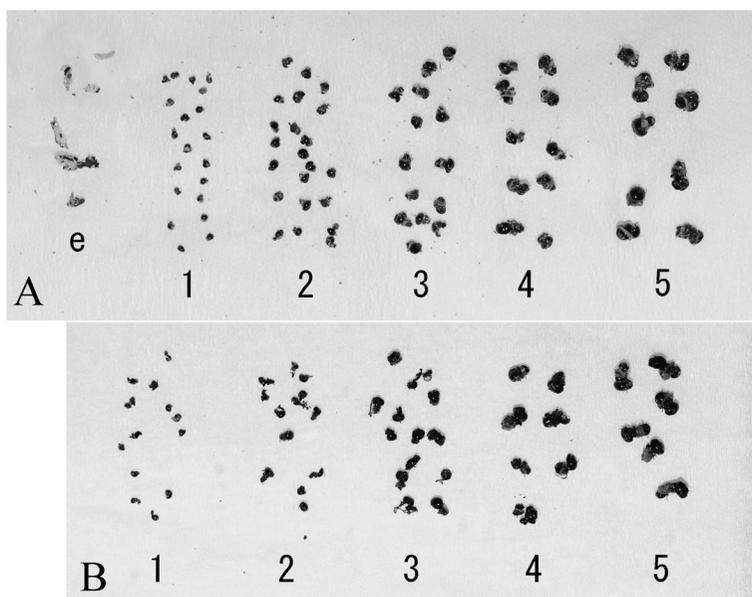


Fig. 2. *Pamphilius montanus montanus*, remains of egg shells (e) and cast skins of 1st (1) to 5th (5) instar larvae found in two larval nests.—A, Yumi-ike, photographed on August 28, 2007; B, Mt. Kasa-dake, photographed on August 10, 2009. All photographs taken by H. Kojima.

ing a few adjacent leaves (Fig. 1I), and it contained feces as well as cast skins of the larvae and remains of egg shells (Fig. 2). The cast skins were classified into five different size classes, apparently corresponding to the first to fifth instars (Fig. 2). Although some cast skins were apparently lost, 22 cast skins of the second instar larvae were left in the nest, indicating at least 22 larvae were originally present in the nest.

B) On July 24, 2009, Kojima found another nest of pamphiliid larvae just as described above on the leaves of *Sorbus commixta* near Mt. Kasadake (1910 m), Nagano Prefecture. A total of 15 larvae matured in the period from July 29 to August 5; of these, two were preserved in ethanol and others went into the soil. Two male adults emerged on May 2, 2010, while the others died during the winter.

Larvae. Of the 15 larvae examined in the case B above, three were about 15 mm long and 12 were about 18–20 mm long when they matured. Since the two male adults emerged from smaller larvae, we assume larger larvae were females and smaller ones were males. Last instar (Fig. 1J): Head black; antenna and palps brown; trunk pale green; prothoracic shields (one large dorsal and two lateral ones), cervical sclerite, spot just above each thoracic leg, median and lateral basins of suranal plate, suranal hook, subanal lobe, and often coxa of each thoracic leg and paired spots on each thoracic sternum blackish.

Notes on life history. *Pamphilius montanus montanus* is probably univoltine as in other species of the genus, and the occurrence of the adults is in July and larval development in July to August. This agrees with the previous collecting data of the adults. This subspecies is known only by two female specimens, both collected in Nagano Prefecture (Kamikochi–Tokugo, 1500–2100 m alt., and Minoto, about 1850 m alt., in Yatsugatake Mountains) in late July (Shinohara, 2001). This discovery of the larvae was also at higher altitudes (1910 m and 2030 m) in Gunma and Nagano Prefectures in late July and late August.

The eggs were not observed, though some

grouped remains of egg shells were found in the nest (Fig. 2A), suggesting that the eggs were laid in a group on a leaflet. The remaining groups of egg shells were on or near the midvein on the undersurface. The larvae are gregarious leaf-feeders making a closed nest with silk combining a few adjacent leaves (Fig. 1I). After all larvae left the nest, it contained only feces and cast larval skins which are useful in estimating the number of the larvae actually present in the nest as well as the number of the molts (Fig. 2, see above). The two nests examined contained at least 22 and 15 larvae, respectively, and there were six (possibly five in males) instars (Fig. 2).

Comparative comments. The gregarious larvae of *P. montanus montanus* make a web nest on *Sorbus commixta* and are characterized by the black head and the richly black-marked thorax and caudal abdominal segment, as described above. The nest resembles a communal larval nest of another pamphiliid, *Neurotoma iridescens* (André, 1882), which feeds on the same plant species in the same locality (Kojima, unpublished). The larva of *N. iridescens* is easily separated from that of *P. montanus montanus* by its reddish coloration. The larva of *P. gracilis* also feeds on *Sorbus commixta*, but it is a solitary leaf-roller having a brown head and a mostly unicolorous pale green trunk (Shinohara and Hara, 1992, 2005).

In Europe, three species of pamphiliids are known to feed on *Sorbus*, namely, *N. iridescens*, *P. sylvaticus* (Linnaeus, 1758) and *P. aucupariae* Vikberg, 1971 (Viitasaari, 2002b). Although the larvae of the two *Pamphilius* species are usually gregarious, their nest in early stage is a leaf-roll or a simple shelter or a collection of these, different from the web nest of *Neurotoma* species (Viitasaari, 2002b). The nest of *P. montanus montanus* in late stage looks similar to that of *N. iridescens*, but we have not seen the nest of the young larvae. Unlike the larva of *P. montanus montanus*, the larva of both *P. sylvaticus* and *P. aucupariae* has a brownish head and no black marks on the caudal abdominal segment (Lorenz and Kraus, 1957; Viitasaari, 2002b).

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