

## Some Biological Features of Three *Pamphilius* Species (Hymenoptera, Pamphiliidae) Feeding on Alders in Nagano Prefecture, Honshu, Japan: Results of Rearing Experiments in 2004/2005

Akihiko Shinohara<sup>1</sup> and Haruyoshi Kojima<sup>2</sup>

<sup>1</sup> Department of Zoology, National Science Museum,  
3–23–1 Hyakunin-cho, Shinjuku-ku, Tokyo, 169–0073 Japan  
e-mail: shinohar@kahaku.go.jp

<sup>2</sup> Kitanagaike 1198–1, Nagano-shi, Nagano, 381–0025 Japan

**Abstract** Host plants and position of the eggs and larval leaf-rolls are recorded for three *Pamphilius* species feeding on *Alnus* in Nagano Prefecture, central Honshu, based on rearing experiments made in 2004 to 2005. Host records are *Alnus hirsuta* Turcz. for *Pamphilius nakagawai* Takeuchi, 1930, *P. archiducalis* Konow, 1897, and *P. flavipectus* Shinohara, 2005, and *Alnus matsumurae* Call. for *P. nakagawai* and *P. flavipectus*. *Alnus matsumurae* is the first host record for *P. flavipectus*. Oviposition and leaf-rolls of *P. nakagawai* and *P. archiducalis* are usually on the under surface of the leaf, whereas those of *P. flavipectus* are on the upper surface of the leaf. The position of the eggs and leaf-rolls are newly recorded for *P. flavipectus*. The adults of *P. flavipectus* emerged one to three weeks later than those of *P. nakagawai*.

**Key words:** Hymenoptera, Pamphiliidae, *Pamphilius*, host plant, larval leaf-roll, *Alnus*.

Larvae of the leaf-rolling sawflies of the genus *Pamphilius* feed on leaves of angiosperm plants, making leaf-rolls singly or gregariously. Twelve species of the genus are now known to feed on alders (*Alnus*) worldwide, including eight species from Japan (Shinohara, 2002, 2005). Five Japanese species of the *P. vafer* complex as defined by Shinohara (2005) are associated with four species of alders, and the five species apparently differ in their host preference and the position of the eggs and larval leaf-rolls. *Pamphilius masao* Shinohara, 2005, and *P. confusus* Shinohara, 2005, are associated with *Alnus maximowiczii* Call. (*P. masao* also with *Betula ermanii* Cham.), and the eggs and leaf-rolls are on the upper surface of the leaf. *Pamphilius alnivorus* Shinohara, 2005, feeds on *Alnus hirsuta* Turcz. and *Alnus japonica* (Thunb.) Steud. and the eggs are laid on the upper surface of the leaf, while the leaf-rolls are on the under surface. *Pamphilius nakagawai* Takeuchi, 1930, feeds on *Alnus hirsuta* and *Alnus matsumurae* Call., and the eggs and leaf-rolls are usually on the under surface. The remaining

species, *P. flavipectus* Shinohara, 2005, is known to feed on *Alnus hirsuta* but the position of the eggs and leaf-rolls is unknown. The current knowledge presented above is nevertheless based on a few rearing results and needs to be assessed by additional observations and rearing experiments.

The present paper reports a result of rearing experiments of the alder-associated *Pamphilius* conducted by the junior author in the northern and eastern parts of Nagano Prefecture, central Honshu, in 2004 to 2005. Attempts were made to rear the pamphiliid larvae feeding on two species of alders, *Alnus hirsuta* and *A. matsumurae*, to the adult stage, in order to test and enrich the current knowledge of the host preference, oviposition sites, and position of leaf-rolls for each of the reared species.

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## Materials and Methods

Larval leaf-rolls on two species of alders, *Alnus hirsuta* and *A. matsumurae*, were searched for in June, 2004, in the following four localities in Nagano Prefecture:

- A. Yumine [36°39.78'N, 138°25.09'E], 1340 m, Takayama-mura. On *Alnus hirsuta*.
- B. Biwa-ike [36°43.35'N, 138°28.96'E], 1400 m, Shiga-kogen, Yamanouchi-machi. On *Alnus hirsuta*.
- C. Mikuni-toge [35°58.76'N, 138°42.74'E], 1730 m, Kawakami-mura. On *Alnus hirsuta*.
- D. Yamanokami [36°39.17'N, 138°26.09'E], 1500 m, Takayama-mura. On *Alnus matsumurae*.

For each leaf-roll, the position of the remains of the egg shell and the direction of the roll were recorded. The obtained larvae were reared in a room at Kitanagaike in Nagano City at an altitude of 335 m. Reaching maturity, each larva was released to an individual jar containing ordinary untreated soil collected at Biwa-ike. The jar with the larva was kept in a room through summer, autumn and winter until the emergence of the adult. The temperature of the room was not controlled, except that the highest temperature was set at 23°C during mid summer (from mid July to the end of August).

The reared adult specimens are deposited in the National Science Museum, Tokyo. For the scientific names of the host plants, we followed Ito (1989).

## Results and Discussion

A total of 54 larvae were found in the four localities in Nagano Prefecture, 37 larvae feeding on *A. hirsuta* in Yumine on June 9 and 30, 10 larvae feeding on *A. hirsuta* in Biwa-ike on June 10, five larvae feeding on *A. hirsuta* in Mikuni-toge on June 13, and two larvae feeding on *A. matsumurae* in Yamanokami on June 15. Of these, 27 larvae died mainly in the soil, whereas 26 adults as well as one ichneumonid parasite emerged in April-May, 2005. The 26 adult pamphiliids obtained were 13 females and one male

of *Pamphilius nakagawai*, one female of *P. archiducalis*, and nine females and two males of *P. flavipectus*. Table 1 shows the details of the 26 cases where adults emerged successfully.

### *Pamphilius nakagawai* Takeuchi, 1930

One female was reared from larva feeding on *A. matsumurae* and 12 females and one male were reared from larvae feeding on *A. hirsuta*. These two species of alders are already known as hosts of this sawfly (Ishii, 1952; Shinohara, 2005).

For all the 14 individuals reared, the larval leaf-rolls were on the under surface of the leaf. The remains of the egg shell were found in six cases, two on the upper surface and four on the under surface. Shinohara (2005) suggested that *P. nakagawai* female usually oviposits on the under surface of the leaf and the larva rolls the edge of the leaf in the direction of the under surface. The present observation showed that the eggs may be deposited also on the upper surface though more frequently on the under surface.

### *Pamphilius archiducalis* Konow, 1897

One female was reared from larva feeding on *A. hirsuta*. The known host plants of this species are *A. hirsuta* and *A. matsumurae* (Shinohara & Hara, 1999; Shinohara, 2005).

So far as is known, the egg of this species is deposited on the under surface of the leaf and the larval leaf-roll is also on the under surface (Shinohara & Hara, 1999). The larval abode here treated was on the under surface of the leaf but the remains of the egg shell were not found, presumably consumed by the larva.

### *Pamphilius flavipectus* Shinohara, 2005

Eight female and two male adults were obtained from the larvae feeding on *A. hirsuta* and one female adult from the larva feeding on *A. matsumurae*. *Alnus hirsuta* is the only known host plant of *P. flavipectus* (Shinohara, 2005), and this is the first record of *A. matsumurae* for the host plant of this sawfly species.

The positions of the egg shell and larval leaf-

Table 1. Rearing records of 26 individuals of three *Pamphilius* species feeding on two alder species.

Ref. No.	species	sex	locality	collection of larva	larva going into soil	emergence of adult	host plant	position of egg shell	position of leafroll
1	<i>P. nakagawai</i>	♀	Biwa-ike	10.VI.2004	16.VI.2004	8.IV.2005	<i>A. hirsuta</i>	not found	under surface
2	<i>P. nakagawai</i>	♀	Biwa-ike	10.VI.2004	23.VI.2004	14.IV.2005	<i>A. hirsuta</i>	upper surface	under surface
3	<i>P. nakagawai</i>	♀	Biwa-ike	10.VI.2004	18.VI.2004	14.IV.2005	<i>A. hirsuta</i>	not found	under surface
4	<i>P. nakagawai</i>	♀	Biwa-ike	10.VI.2004	16.VI.2004	16.IV.2005	<i>A. hirsuta</i>	not found	under surface
5	<i>P. nakagawai</i>	♀	Yumine	9.VI.2004	16.VI.2004	8.IV.2005	<i>A. hirsuta</i>	under surface	under surface
6	<i>P. nakagawai</i>	♀	Yumine	9.VI.2004	16.VI.2004	12.IV.2005	<i>A. hirsuta</i>	not found	under surface
7	<i>P. nakagawai</i>	♀	Yumine	9.VI.2004	18.VI.2004	14.IV.2005	<i>A. hirsuta</i>	upper surface	under surface
8	<i>P. nakagawai</i>	♀	Yumine	9.VI.2004	20.VI.2004	14.IV.2005	<i>A. hirsuta</i>	uncertain*	under surface
9	<i>P. nakagawai</i>	♂	Yumine	9.VI.2004	16.VI.2004	14.IV.2005	<i>A. hirsuta</i>	not found	under surface
10	<i>P. nakagawai</i>	♀	Yumine	9.VI.2004	20.VI.2004	14.IV.2005	<i>A. hirsuta</i>	under surface	under surface
23	<i>P. nakagawai</i>	♀	Yamanokami	15.VI.2004	28.VI.2004	14.IV.2005	<i>A. matsumurae</i>	uncertain*	under surface
25	<i>P. nakagawai</i>	♀	Mikumi-toge	13.VI.2004	24.VI.2004	9.IV.2005	<i>A. hirsuta</i>	under surface	under surface
26	<i>P. nakagawai</i>	♀	Mikumi-toge	13.VI.2004	20.VI.2004	12.IV.2005	<i>A. hirsuta</i>	not found	under surface
27	<i>P. nakagawai</i>	♀	Mikumi-toge	13.VI.2004	22.VI.2004	14.IV.2005	<i>A. hirsuta</i>	under surface	under surface
13	<i>P. archiducalis</i>	♀	Yumine	30.VI.2004	8.VII.2004	16.IV.2005	<i>A. hirsuta</i>	not found	under surface
11	<i>P. flavipectus</i>	♀	Yumine	9.VI.2004	12.VI.2004	14.IV.2005	<i>A. hirsuta</i>	not found	upper surface
12	<i>P. flavipectus</i>	♀	Yumine	9.VI.2004	19.VI.2004	14.IV.2005	<i>A. hirsuta</i>	upper surface	upper surface
14	<i>P. flavipectus</i>	♂	Yumine	9.VI.2004	20.VI.2004	19.IV.2005	<i>A. hirsuta</i>	unrecorded	unrecorded
15	<i>P. flavipectus</i>	♂	Yumine	9.VI.2004	20.VI.2004	20.IV.2005	<i>A. hirsuta</i>	upper surface	upper surface
17	<i>P. flavipectus</i>	♀	Yumine	9.VI.2004	21.VI.2004	27.IV.2005	<i>A. hirsuta</i>	not found	upper surface
18	<i>P. flavipectus</i>	♀	Yumine	9.VI.2004	22.VI.2004	27.IV.2005	<i>A. hirsuta</i>	upper surface	upper surface
19	<i>P. flavipectus</i>	♀	Yumine	9.VI.2004	20.VI.2004	27.IV.2005	<i>A. hirsuta</i>	upper surface	upper surface
20	<i>P. flavipectus</i>	♀	Yumine	9.VI.2004	16.VI.2004	30.IV.2005	<i>A. hirsuta</i>	upper surface	upper surface
21	<i>P. flavipectus</i>	♀	Yumine	9.VI.2004	22.VI.2004	7.V.2005	<i>A. hirsuta</i>	upper surface	upper surface
22	<i>P. flavipectus</i>	♀	Yumine	9.VI.2004	22.VI.2004	7.V.2005	<i>A. hirsuta</i>	upper surface	upper surface
24	<i>P. flavipectus</i>	♀	Yamanokami	15.VI.2004	27.VI.2004	23.IV.2005	<i>A. matsumurae</i>	upper surface	upper surface

\*egg shells found on both sides

roll of *P. flavipectus* have been unknown (Shinohara, 2005). In all the 11 larval abodes examined, except for three cases where egg shells were not found, the egg shell and larval abode are both on the upper surface of the leaf (Fig. 1 C–D). No

other species feeding on *Alnus hirsuta* or *A. matsumurae* are known to make leaf-rolls on the upper surface of the leaf.

*Pamphilius flavipectus* is one of the three species of *Pamphilius vafer* complex having a

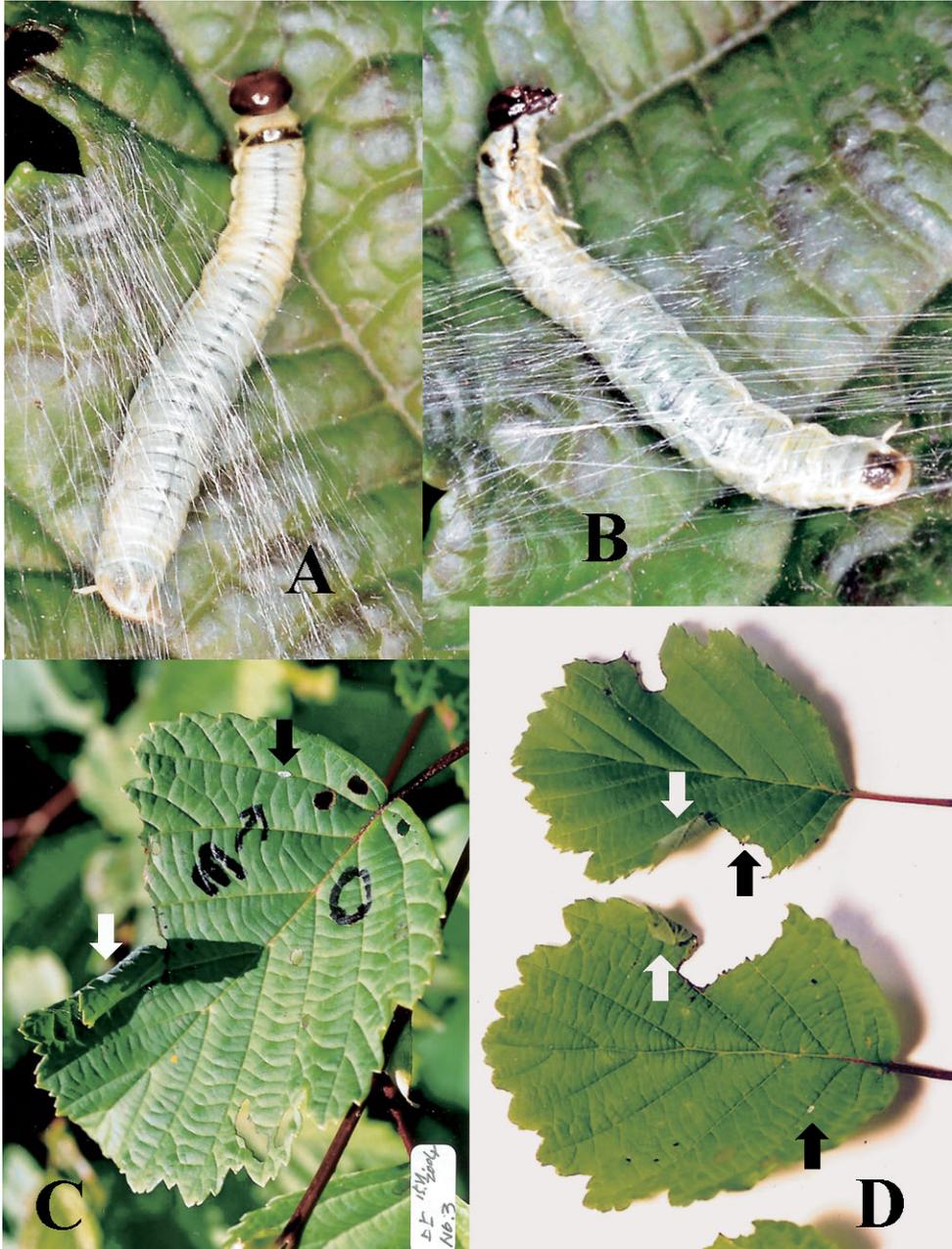


Fig. 1. *Pamphilius flavipectus*, presumably mature larva (A–B) and leaves with remains of egg shells and larval leaf-rolls (C–D) (photographed by H. Kojima in June, 2004). Black arrows: remains of egg shells. White arrows: larval leaf-rolls (abodes).

long stout valvices in the male genitalia (Shinohara, 2005). It is interesting that in the other two species possessing this character, *P. masao* (on *Alnus maximowiczii* and *Betula ermanii*) and *P. confusus* (on *Alnus maximowiczii* and possibly also on *Betula ermanii*), eggs are laid and leaf-rolls are made on the upper surface of the leaf as in *P. flavipectus*. Sharing these peculiar characters may suggest a very close relationship of these three species.

The larva of this species has been undescribed. The presumably mature larva examined (Fig. 1 A–B) may be distinguished from the mature larvae of the related *P. masao*, *P. nakagawai* and *P. alnivorus* (see Okutani, 1959; Shinohara, 2005; Shinohara & Hara, 2005) by the presence of a black spot on the subanal plate.

### Biological differences between *P. nakagawai* and *P. flavipectus*

*Pamphilius nakagawai* and *P. flavipectus* are often found in the same habitat in the same season and the larvae feed on the same species of alders (Shinohara, 2005; present paper). The present work has revealed, however, the following differences in biology between them:

1. The female of *P. nakagawai* lays an egg usually on the under surface of the leaf (sometimes also on the upper surface), while that of *P. flavipectus* oviposits on the upper surface.

2. The larval leaf-roll is on the under surface in *P. nakagawai*, while it is on the upper surface in *P. flavipectus*.

3. The adult emergence is earlier in *P. nakagawai* than in *P. flavipectus*. Table 2 shows that 14 adults of *P. nakagawai* emerged between April 8 and 16, 2005, whereas 11 adults of *P. flavipectus* emerged between April 14 and May 7, 2005. These individuals were all collected during the period of June 9 to 15, 2004, as larvae, and they reached maturity and went into the soil between June 12 and 28 (Table 1). Of these, three larvae of *P. nakagawai* collected at Yumine on June 9, 2005, went into the soil on June 16, and the adults emerged on April 8, 12, and 14, respectively, in the next year. One larva of *P. flavipectus*

Table 2. Date of adult emergence in *P. nakagawai* and *P. flavipectus* (edited from data given in Table 1).

Date	Number of individuals	
	<i>nakagawai</i>	<i>flavipectus</i>
2005 April 8	2	
9	1	
12	2	
14	8	2
16	1	
19		1
20		1
23		1
27		3
30		1
May 7		2

collected at the same place and date (Yumine, June 9, 2004) went into the soil on the same date as above (June 16), but the adult emerged on April 30, 2005. For another example, two larvae of *P. nakagawai* and three larvae of *P. flavipectus* were collected at Yumine on June 9, 2004, and all went into the soil on June 20. Two adults of *P. nakagawai* emerged on April 14, 2005, while the adults of *P. flavipectus* emerged on April 19, 20, and 27. It is apparent that the adults of *P. flavipectus* emerge one to three weeks later than *P. nakagawai* under the same environmental conditions. This observation implies that *P. flavipectus* has a shorter incubation and larval period than *P. nakagawai*, a hypothesis to be tested by further rearing experiments.

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