

## Host Plants and Larvae of Three Species of the Sawfly Genus *Onycholyda* (Insecta, Hymenoptera, Pamphiliidae) in Japan

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**Abstract** Based on the rearings in 2007 to 2008 in Nagano Prefecture, central Honshu, the following host plants are newly recorded for two species of leaf-rolling sawflies of the genus *Onycholyda*: *Rubus idaeus* L. subsp. *nipponicus* Focke var. *hondoensis* Koidz., *R. vernus* Focke and *R. ikenoensis* H. Lév. et Vaniot for *O. tenuis* (Takeuchi, 1938) and *R. crataegifolius* Bunge for *O. esakii* (Takeuchi, 1938). Host plants were unknown for *O. esakii*. The larvae are described for the first time for *O. tenuis* and *O. esakii*. Reports on the rearings of the three species of *Onycholyda*, *O. tenuis*, *O. esakii*, and *O. viriditibialis* (Takeuchi, 1930) are given, with comments on the identification and biology.

**Key words:** Hymenoptera, Pamphiliidae, *Onycholyda*, larvae, *Rubus*, life history.

Larvae of the pamphiliid sawfly genus *Onycholyda* are leaf-rollers on mainly Rosaceous plants (Shinohara, 2002). Host plants are known only for 11 species. Seven species are known to feed on *Rubus* (Middlekauff, 1964; Shinohara and Okutani, 1983; Shinohara, 1987), two species on *Filipendula* (Kangas and Syrjänen, 1962; Shinohara and Okutani, 1983), and one species each on *Agrimonia* (Shinohara, 2006) and *Cornus* (Middlekauff, 1964).

In Japan, Okutani and Fujita (1955, 1956) reported on the host plants and biology of *O. lucida* (Rohwer, 1910) and *O. viriditibialis* (Takeuchi, 1930) and described the larvae of the two species. Okutani (1967) newly recorded the host of *O. minomalis* (Takeuchi, 1930) based on rearing, whereas Shinohara and Okutani (1983) and Shinohara (1987) first recorded the hosts of *O. kumamotonis* (Matsumura, 1912) and *O. tenuis* (Takeuchi, 1938), respectively, based on the observation of the oviposition. For these three species, the larvae still remain undescribed. Shinohara (2006) recorded the host plant of *O. decorata* Shinohara, 1985, and described the larvae for the first time. Of the ten species of *Onycholy-*

*da* occurring in Japan, therefore, host plants are known for six species and larvae have been described for three species.

In the present paper, we will give observations on the larvae and life history of three species, *O. tenuis*, *O. viriditibialis*, and *O. esakii* (Takeuchi, 1938), all feeding on *Rubus* spp., in Nagano Prefecture, central Honshu, Japan. The larvae of the three species are briefly described. For *O. esakii*, host plants were unknown, and for *O. tenuis* and *O. esakii*, the larvae have been undescribed.

The rearing was made by Kojima in a room at Kitanagaike in Nagano City, Nagano Prefecture, at an altitude of 335 m. On maturity, each larva was released to an individual jar containing ordinary untreated soil. 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 Museum of Nature and Science, Tokyo. For the scientific names of the host plants and larval morphological terminology, we

followed Yonekura and Kajita (2009) and Vitasaari (2002), respectively.

***Onycholyda tenuis*** (Takeuchi, 1938)

(Table 1, Figs. 1, 3)

*Host plants.* *Rubus subcrataegifolius* (H. Lév. et Vaniot) H. Lév. (see Shinohara, 1987); *R. idaeus* L. subsp. *nipponicus* Focke var. *hondoensis* Koidz. (new record); *R. vernus* Focke (new record); *R. ikenoensis* H. Lév. et Vaniot (new record). In the laboratory, oviposition was made also on cultivated *R. idaeus* L. subsp. *idaeus* and *R. fruticosus* L. (s. l.).

*Rearings.* In September 2007, Kojima found eleven larval abodes of this species on three species of *Rubus* in Tsugaike and Mt. Obinatayama, Nagano Prefecture. They were two leaf-rolls on *R. idaeus* subsp. *nipponicus* var. *hondoensis* and one leaf-roll on *R. ikenoensis* in Tsugaike (36°46'N 137°49'E, 1,870 m alt.) and eight leaf-rolls on *R. vernus* on Mt. Obinatayama (36°44'N 137°47'E, 1,600–1,700 m alt.) (Table 1). Each leaf-roll contained only one larva, with the exception of two leaf-rolls on *R. vernus*, each of them containing two larvae. All the larvae matured and went into the soil within 17 days after they were collected and all, except two, became adults and emerged in May, 2008, in Nagano City (335 m alt.). A female that emerged oviposited on cultivated *R. idaeus* subsp. *idaeus* and *R. fruticosus* L. (s. l.) but an attempt to rear them failed.

*Larva.* Late instar (Fig. 1E–F): Length about 14 mm in male and 16–17 mm in female; head capsule pale greenish brown, with posterior ventral margins of genae, clypeus and labrum largely blackish brown; antenna dark brown, basal and intersegmental areas creamy white; mandible blackish brown. Trunk greenish white, anal parts brownish; prothoracic and lateral shields pale greenish brown; cervical sclerite blackish brown; thoracic legs creamy white; subanal appendage creamy white.

*Notes on life history.* This species probably has one generation a year. The adults emerged in

May under experiment conditions in Nagano City (335 m alt.), though the adults should have occurred in August in Tsugaike (1,870 m alt.) and Mt. Obinatayama (1,600–1,700 m alt.) because the larvae were found in early September there.

Usually one egg is laid along the main or lateral vein of the underside of a leaf (Fig. 1I). Sometimes, two eggs were found on the same leaf in the field and more eggs may be laid on one leaf under experiment conditions (Fig. 1B) but not in a group. The larva is usually solitary, though two larvae were found in one leaf-roll in two of the eleven cases observed (Table 1). The leaf-rolls are always made on the underside of the leaf.

***Onycholyda viriditibialis*** (Takeuchi, 1930)

(Table 1, Figs. 2A–D, 3)

*Host plant.* *Rubus crataegifolius* Bunge (see Okutani and Fujita, 1956).

*Rearings.* On September 3, 2007, Kojima found a leaf-roll containing six late instar larvae on *Rubus crataegifolius* Bunge in Tsugaike (36°46'N 137°50'E, 1,570–1,580 m alt.), Nagano Prefecture. They reached maturity on September 6 and went into the soil in Nagano City (335 m alt.). Two male adults emerged on June 17, 2008, and one female on June 18, whereas the remaining adults did not emerge in 2008 (Table 1).

The emerged female deposited nine eggs on one leaf and 15 eggs on another leaf on June 18–20, 2008, the eggs being laid in a small group. Seven eggs on one leaf and eight eggs on the other leaf hatched on June 27, while the others died. All the larvae (some of them shown in Fig. 2B) matured and buried themselves in the soil on July 10–14, except for one larva that entered the soil on July 17.

On August 27, 2008, Kojima found a leaf-roll containing two larvae on *R. crataegifolius* on Mt. Obinatayama (36°44'N 137°47'E, 1,520 m alt.), Nagano Prefecture. The larvae went into the soil on September 2.

*Larva.* Late instar (Fig. 2C–D): Length about 15–16 mm in male and 17–20 mm in female;

Table 1. Rearing data of *Onycholyda tenuis* and *O. viriditibialis*.

Species	Locality	Leaf-roll	Host	Larva collected	Matured	Adult emerged	Sex	Remarks
<i>Onycholyda tenuis</i>	Tsuigaiké	T1	<i>Rubus idaeus</i> subsp. <i>nipponicus</i> var. <i>hondoensis</i>	3. IX. 2007	20. IX.	27. V. 2008	♀	Fig. 1C–F, I
		T2	<i>Rubus idaeus</i> subsp. <i>nipponicus</i> var. <i>hondoensis</i>	29. IX. 2007	4. X.	15. V. 2008	♀	Fig. 1J, oviposited on <i>Rubus idaeus</i> subsp. <i>idaeus</i> .
		T3	<i>Rubus ikenoensis</i>	3. IX. 2007	9. IX.	25. V. 2008	♀	Fig. 1K, oviposited on <i>Rubus idaeus</i> subsp. <i>idaeus</i>
	T4	<i>Rubus vernus</i>	8. IX. 2007	9. IX.	16. V. 2008	♀	Fig. 1G–H	
	T5	<i>Rubus vernus</i>	8. IX. 2007	10. IX.	21. V. 2008	♀	parasite emerged on May 9, 2008	
	T6	<i>Rubus vernus</i>	8. IX. 2007	10. IX.	29. V. 2008	♂		
	T7	<i>Rubus vernus</i>	8. IX. 2007	10. IX.		dead		
	T8	<i>Rubus vernus</i>	8. IX. 2007	11. IX.	10. V. 2008	♀		
	T9	<i>Rubus vernus</i>	8. IX. 2007	12. IX.	5. V. 2008	♀		
	T10	<i>Rubus vernus</i>	8. IX. 2007	12. IX.	21. V. 2008	♀		
	T11	<i>Rubus vernus</i>	8. IX. 2007	12. IX.	25. V. 2008	♀		
<i>Onycholyda viriditibialis</i>	Tsuigaiké	V1	<i>Rubus crataegifolius</i>	3. IX. 2007	6. IX.	17. VI. 2008	♂	Fig. 2C; three additional larvae in the leaf-roll matured on 6. IX. but did not emerge in 2008; female oviposited on 18–20. VI. 2008.
	Obinatayama	V2	<i>Rubus crataegifolius</i>	27. VIII. 2008	2. IX.	?	?	Fig. 2D; adult emergence to be expected in 2009.

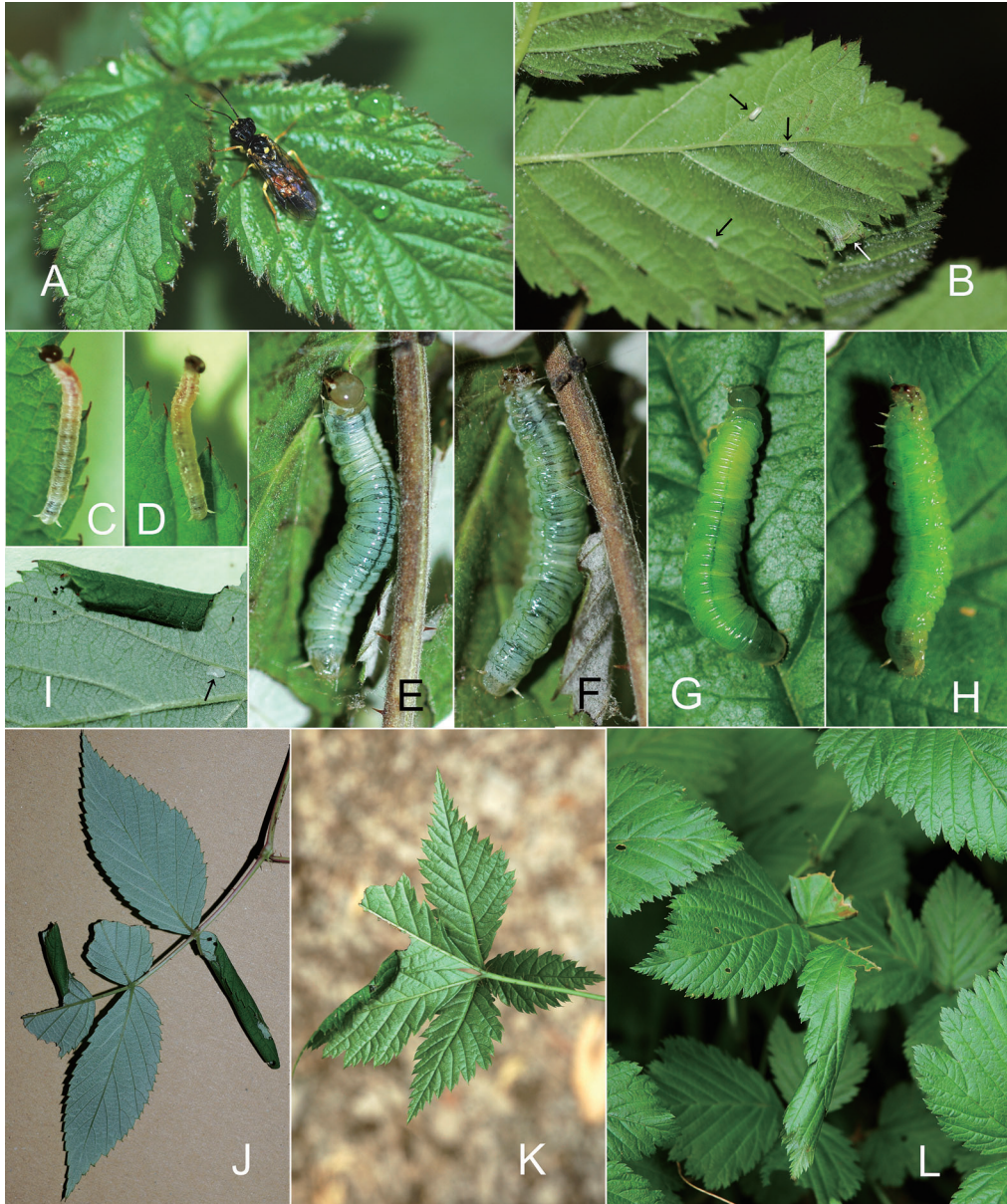


Fig. 1. *Onycholyda tenuis*, adult (A), immature stages (B–H) and larval abodes (I–L) — A, Female reared from larva feeding on *Rubus vernus* at Mt. Obinatayama on September 8, 2007, photographed on May 6, 2008; B, eggs (black arrows) and 1st instar larva (white arrow) on cultivated *R. idaeus* subsp. *idaeus*, photographed on June 6, 2008; C–D, probably 3rd instar larva feeding on *R. idaeus* subsp. *nipponicus* at Tsugaike, photographed on September 7, 2007; E–F, probably 5th instar larva feeding on *R. idaeus* subsp. *nipponicus* at Tsugaike, photographed on September 18, 2007; G–H, mature larva, which fed on *R. vernus* at Mt. Obinatayama, photographed on September 10, 2007; I, leaf-roll and remains of egg (black arrow) on *R. idaeus* subsp. *nipponicus* at Tsugaike, photographed on September 3, 2007; J, leaf-rolls on *R. idaeus* subsp. *nipponicus* at Tsugaike, photographed on September 29, 2007; K, leaf-roll on *R. ikenoensis* at Tsugaike, photographed on September 3, 2007; L, leaf-roll on *R. vernus* at Mt. Obinatayama, photographed on September 8, 2007. All photographs taken by H. Kojima.

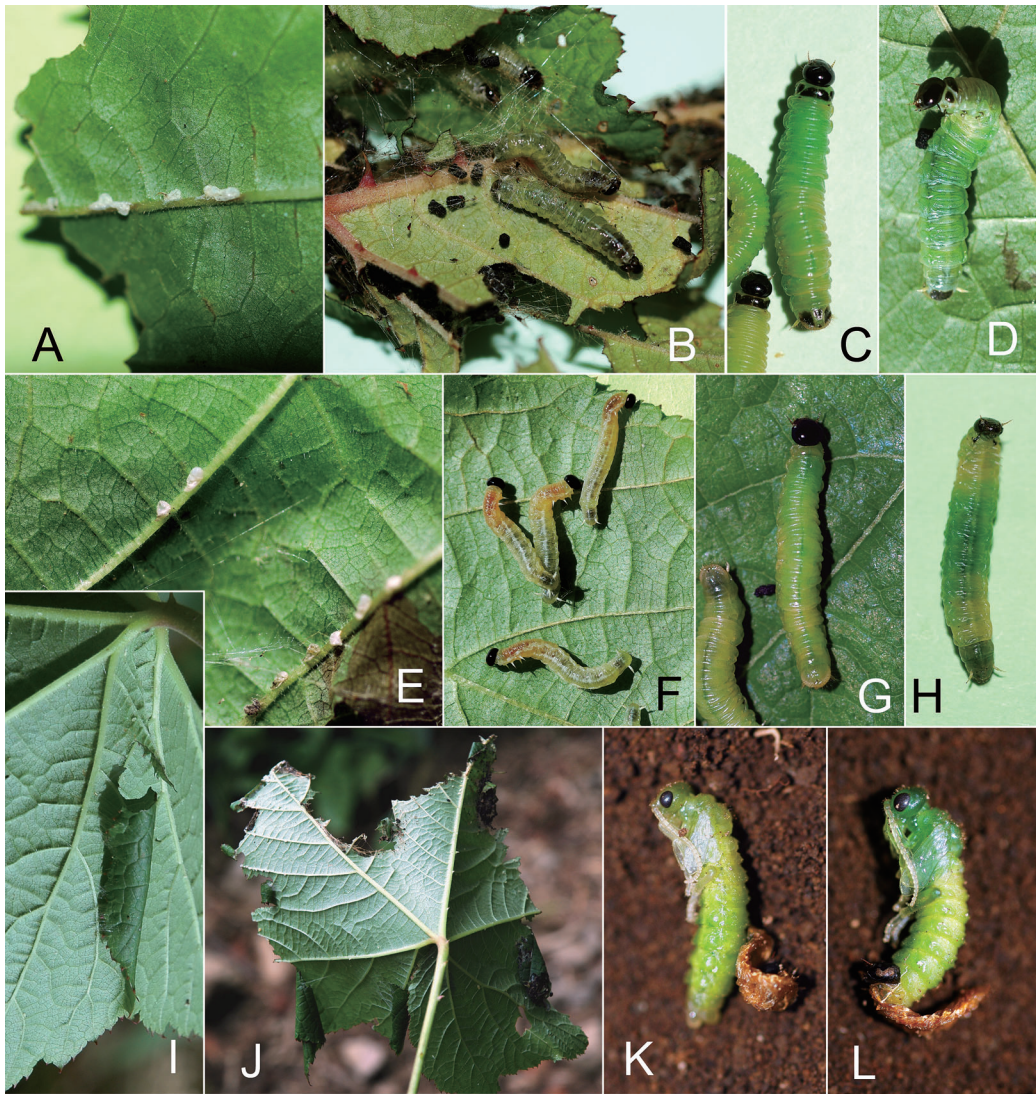


Fig. 2. *Onycholyda viriditibialis* (A–D) and *O. esakii* (E–L) on *R. crataegifolius*. — A, Remains of eggs on the vein of a leaf, Mt. Obinatayama, photographed on August 28, 2008; B, gregarious late instar larvae, offspring of a female reared from larva collected at Tsugaïke, September 3, 2007, photographed on July 7, 2008; C, mature larva, collected at Tsugaïke on September 3, 2007, photographed on September 6; D, late instar larva, collected at Mt. Obinatayama on August 27, 2008, photographed on August 31; E, remains of eggs on the veins of a leaf, Tsugaïke, photographed on September 6, 2007; F, late instar larvae collected at Mt. Obinatayama on August 27, 2008, photographed on August, 31; G, mature larva, same collection data, photographed on September 2; H, mature larva, same collection data, photographed on September 6; I, leaf-roll, photographed at Tsugaïke on September 3, 2007; J, leaf with several leaf-rolls, same data; K, male pupa, collected as larva at Tsugaïke on September 3, 2007, photographed on April 30, 2008 (emerged on May 5); L, female pupa, collected as larva at Tsugaïke on September 3, 2007, photographed on May 11, 2008 (emerged on May 20). All photographs taken by H. Kojima.

head capsule and labrum black; antenna pale brown; mandible blackish brown. Trunk pale green; prothoracic and lateral shields black; cervical sclerite black; each thoracic surpedal lobe with small blackish spot; thoracic legs greenish white, with coxae black-marked; suranal lobe with four black spots, large lateral, anteromedian and small posteromedian spots; subanal lobe with very large black median spot; subanal appendage creamy white.

*Notes on life history.* There is one generation a year. The adults emerge in early June to early July in Sasayama, Hyogo Prefecture, western Honshu (Okutani and Fujita, 1956) and also in Nagano City (335 m alt.), in central Honshu. At higher altitudes, such as Tsugaike (1,570–1,580 m alt.), Nagano Prefecture, the adults should emerge later in summer, as suggested by the occurrence of late instar larvae in early September.

The eggs are laid on the lateral vein of the underside of a leaf in a linear group of one to eight eggs (Fig. 2A; Okutani and Fujita, 1956). Two or more egg groups are often found on one leaf. The incubation period was about ten days in Sasayama in May, 1955 (Okutani and Fujita, 1956), while it was seven to ten days in Nagano City in June, 2008. The eggs in a group hatch almost simultaneously and the larvae from the same group of eggs live in one leaf-roll gregariously (Fig. 2B), as noted by Okutani and Fujita (1956). When the larval density is high on a leaf, originally independent nearby leaf-rolls may sometimes unite into one larger abode. The leaf-rolls are always made on the underside of the leaf. The larval period was 13–20 days in our rearing in Nagano City (335 m alt.) in June 2008, while it was 14–16 days in Sasayama in May 1955, and 11–15 days in Sasayama in July 1956 (Okutani and Fujita, 1956).

***Onycholyda esakii* (Takeuchi, 1938)**

(Table 2, Figs. 2E–L, 3)

*Host plant.* *Rubus crataegifolius* Bunge (new record).

*Rearings.* On September 3, 2007, Kojima found seven leaf-rolls on *Rubus crataegifolius* Bunge in Tsugaike (36°46'N 137°50'E, 1,570–1,580 m alt.), Nagano Prefecture (Fig. 2I–J). As detailed in Table 2, the abodes contained one to ten larvae, which matured on September 7–13 and went into the soil in Nagano City (335 m alt.). Of the 34 larvae reared, 31 individuals became adults in 2008. Most of them (18 males and six females) emerged during the period from April 27 to May 21, while seven individuals (five males and two females) emerged later in the season (June 23 to July 2 and July 20) (Table 2, Fig. 3). A female that emerged on June 30, 2008, deposited eggs on July 1–3 and the three larvae from these eggs reached maturity and entered the soil on July 28–30.

On August 27, 2008, Kojima found three leaf-rolls on *R. crataegifolius* on Mt. Obinatayama (36.44N 137.47E, 1,520 m alt.), Nagano Prefecture. One leaf-roll contained five larvae, three of which matured on September 2 and the remaining two on September 6. Another abode included five larvae; one of them went into the soil on September 3, three on September 6, and the last one on September 8. The third leaf-roll contained four larvae, two of which reached maturity on September 4, one on September 7, and one on September 8.

*Larva.* Late instar (Fig. 2G–H): Length about 14–17 mm in male and 19–21 mm in female; head capsule and labrum black; antenna dark brown; mandible blackish brown. Trunk pale green; prothoracic and lateral shields pale brownish green; cervical sclerite black; thoracic legs greenish white; anal part slightly brownish, without black marking; subanal appendage creamy white.

*Notes on life history.* There is probably one generation a year. The adult emergence apparently shows rather irregular polymodal pattern in our rearing, the major emergence in the end of April to May and a minor emergence in late June to July in Nagano City (335 m alt.) (see above, Fig. 3). In Tsugaike (1,570–1,580 m alt.), however, feeding larvae were found in early September,

Table 2. Rearing data of *Onycholyda esakii* on *Rubus crataegifolius* found as larvae at Tsugaikae, Nagano Prefecture, on September 3, 2007.

Leaf-roll	Larva matured	Adult emerged	Sex	Remarks
E1	7. IX.	3. V. 2008	♂	
		5. V. 2008	♂	
		7. V. 2008	♂	
	9. IX.	11. V. 2008	♂	
		13. V. 2008	♂	
		20. VII. 2008*	♂	
E2	7. IX.	27. IV. 2008	♂	One additional larva in the leaf-roll matured on 9. IX. but did not emerge in 2008.
		9. V. 2008	♂	
		11. V. 2008	♂	
	11. IX.	30. VI. 2008	♀	
E3	7. IX.	28. IV. 2008	♂	
		29. IV. 2008	♂	
		1. V. 2008	♂	
		2. V. 2008	♂	
		5. V. 2008	♂	
	9. IX.	8. V. 2008	♂	
		15. V. 2008	♂	
		11. V. 2008	♀	
	10. IX.	15. V. 2008	♀	
		13. V. 2008	♀	
E4	9. IX.	23. VI. 2008	♀	
E5	9. IX.	15. V. 2008	♀	
		16. V. 2008	♀	
E6	9. IX.	5. V. 2008	♂	Fig. 2K–L; two additional larvae in the leaf-roll matured on 12. IX. but one died and one did not emerge in 2008.
	11. IX.	20. VII. 2008*	♂	
	12. IX.	21. V. 2008	♂	
	13. IX.	20. V. 2008	♀	
E7	11. IX.	27. VI. 2008	♂	
		2. VII. 2008	♂	
	12. IX.	20. VII. 2008*	♂	
		14. V. 2008	♂	

\* actually emerged between 11–19.VII

suggesting the occurrence of the adults in August.

In general features of the immature stages and their life history, e.g., the eggs deposited along the lateral veins in a group on the undersurface of the leaf (Fig. 2E), the leaf-rolls on the under-

side of the leaf inhabited by gregarious larvae, *O. esakii* has much in common with *O. viriditibialis*. For the moment, we are not able to distinguish the two species, except for the color pattern of the late instar and mature larvae, as discussed elsewhere.

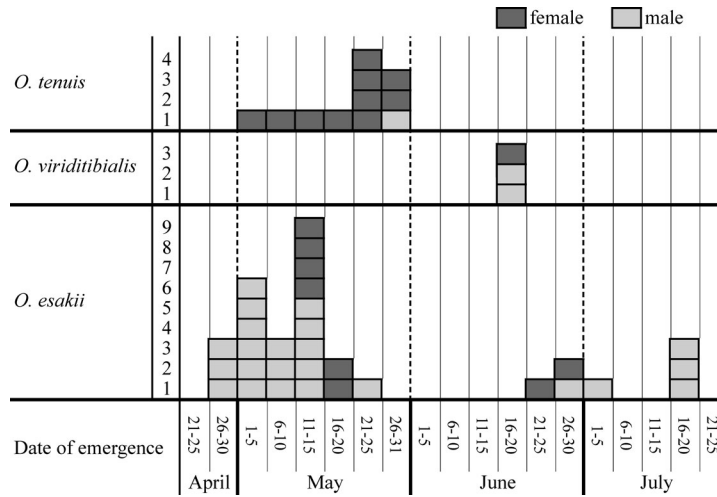


Fig. 3. Number of the adults of the three *Onycholyda* species that emerged in every five/six days from April 21 to July 25 in 2008. Results of rearings in Nagano City, central Japan (see text for details).

## Discussion

### Species Identification

The larvae of the three species treated in this paper differ in their host plants, color pattern and biology. *Onycholyda viriditibialis* and *O. esakii* are known to feed only on *R. crataegifolius*, whereas *O. tenuis* feeds on at least four species of *Rubus*, but not including *R. crataegifolius*. The late instar larvae of *O. viriditibialis* and *O. esakii* have black head capsules and live gregariously in a leaf-roll (Fig. 2B–C, G), while those of *O. tenuis* have pale greenish brown head capsules (Fig. 1E) and usually live singly in a leaf-roll. The two black-headed species attached to *R. crataegifolius* are easily distinguishable by the color of the prothoracic and lateral shields and the terminal abdominal segment; the late instar larva of *O. viriditibialis* has the prothoracic and lateral shields black and the suranal and subanal plates black-marked (Fig. 2C–D), but these areas have no black marks in *O. esakii* (Fig. 2G–H).

*Onycholyda lucida* (Rohwer, 1910) is the only other species of the genus known to feed on *R. crataegifolius* (see Shinohara, 2002). According to the description by Okutani and Fujita (1955), the late instar larva of *O. lucida* is similar in

color pattern to *O. viriditibialis* but is smaller in size and lives solitarily in a leaf-roll.

### Possible Species Differences in Adult Emergence

Figure 3 shows the timing of the adult emergence of *O. tenuis*, *O. viriditibialis* and *O. esakii* based on the rearings in the present work. As noted before, all rearings were made under the same condition. Though the sample size is small, there seem to be certain differences in the adult emergence patterns among the three species.

Adults of *O. tenuis* emerge in May and those of *O. viriditibialis* in the middle of June, whereas those of *O. esakii* show an apparently polymodal emergence pattern as noted above. The possible differences in the adult emergence pattern between *O. viriditibialis* and *O. esakii* may be particularly significant because those two closely related species occur in the same locality and utilize the same plant species as host. If the two species actually differ in the timing of adult emergence and thus oviposition, it may contribute in part to the avoidance of interspecific competition on the same host plant.

### Gregarious Larvae in *O. tenuis*, Abnormal Occurrence?

Unlike the gregarious larvae of *O. viriditibialis*



and *O. esakii*, the larvae of *O. tenuis* are usually solitary, though two of the eleven abodes of *O. tenuis* observed contained two larvae each (Table 1). For each of these two cases, however, one of the two larvae was not able to become an adult; in one case a parasite emerged, and in the other case the larva died for unknown reasons. In all the other cases, where the abodes contained only one larva, the larvae safely became adults. The reason for the occurrence of two larvae in one leaf-roll is unknown, but it may be due to an abnormal behavior caused by parasitization or some kind of infection.

### References

- Kangas, J. K. and A. J. Syrjänen, 1962. Beobachtungen zur Biologie von *Pamphilius sertatus* Knw. (Hymenoptera, Pamphiliidae). *Annales Entomologici Fennici*, **28**: 185–187.
- Middlekauff, W. W., 1964. The North American sawflies of the genus *Pamphilius* (Hymenoptera: Pamphiliidae). *University of California Publications in Entomology*, **38**: 1–84.
- Okutani, T., 1967. Food plants of Japanese Symphyta (I). *Japanese Journal of Applied Entomology and Zoology*, **11**: 43–49. (In Japanese with English abstract.)
- Okutani, T. and E. Fujita, 1955. Studies on Symphyta (II). On the life-history of a Japanese Pamphilid-Sawfly, *Pamphilius lucidus* Rohwer. *Science Reports, Hyogo University of Agriculture*, **2**(1): 80–88.
- Okutani, T. and E. Fujita, 1956. Outline of the life-history of a sawfly *Pamphilius viriditibialis* Takeuchi. (Studies on Symphyta V). *Science Reports, Hyogo University of Agriculture*, **2**(2): 3–10.
- Shinohara, A., 1987. The sawfly genus *Onycholyda* (Hymenoptera, Pamphiliidae) of Japan V. *Kontyû, Tokyo*, **55**: 486–501.
- Shinohara, A., 2002. Systematics of the leaf-rolling or webspinning sawfly subfamily Pamphiliinae: a preliminary overview. In: Viitasaari, M. (ed.), *Sawflies 1 (Hymenoptera, Symphyta)*, pp. 359–438. Tremex Press, Helsinki.
- Shinohara, A., 2006. *Onycholyda decorata* (Insecta, Hymenoptera, Pamphiliidae), a leaf-rolling sawfly feeding on *Agrimonia pilosa* var. *japonica*, found in central Tokyo. *Bulletin of the National Science Museum, Series A*, **32**: 137–141.
- Shinohara, A. and T. Okutani, 1983. Host-plants of Japanese Pamphiliinae (Hymenoptera, Pamphiliidae). *Kontyû, Tokyo*, **51**: 276–281.
- Viitasaari, M., 2002. The Suborder Symphyta of the Hymenoptera. In: Viitasaari, M. (ed.), *Sawflies 1 (Hymenoptera, Symphyta)*, pp. 11–174. Tremex Press, Helsinki.
- Yonekura, K. and T. Kajita, 2009. BG Plants Wamei-Gakumei Index (YList). [http://bean.bio.chiba-u.jp/bgplants/ylist\\_main.html](http://bean.bio.chiba-u.jp/bgplants/ylist_main.html) (Last access on March 16, 2009; in Japanese.)