

Larval development of *Epiophlebia superstes* in Kyushu

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Summary: Since 1968 the author attempted to rear and to check the larval development of *Epiophlebia superstes* in Hitoyoshi, Kyushu. Along with this, the author checked elaborately the larvae of the same species in the field, i. e., at the streams in Hitoyoshi and various places in Kuma-District of Kumamoto Pref.

1. The larvae are found in the mountain valleys covered with primeval forest, where the stream beds are made of sand and pebbles being partly shadowed by trees.

2. The larvae do crawl in the water, but actively in the nighttime. They show negative phototaxis and never swim by jet propulsion. In daytime the younger instar larvae conceal themselves under small rotten wood or dead leaves at the shoals of the stream. After about six instar they move to the underside of small stones where they cling the stone upside down. They take small living creatures, but cannibalism among themselves has not been observed. When touched by hand they feign death, but while younger period such larvae may be washed away by the stream. Grown larvae make friction sound by moving the abdomen.

3. It was confirmed that the total larval period is made of 14 instars.

4. The body-size of the first instar larva is ca. 1.2 mm, body rather hyaline without dark pigments their antenna is composed of only three segments and the legs with a single tarsal segment. In the third instar the body is tinted with pale yellowish with two tarsal segments. In the sixth instar dark patterns appear on the body, developing the stridulating organ on the lateral sides of abdominal segments. In the seventh instar the antennal segments increase four, and the tarsal segments three. In the eighth instar the wing-sheath appears and body coloration becomes much darker. After tenth instar body coloration strongly darkened. After twelfth instar, the minute teeth lining the anterior margin of the median lobe of labium are replaced by strong setae.

5. It was finally confirmed that the whole larval period requires five years in a very quickly developing larva, but usually it takes six years, while the slowly growing individuals need 7-8 years before transformation. Therefore a very lately growing larva changes into adult at the spring of the ninth year!

About the larval life history of *Epiophlebia superstes* Selys.), which is endemic to Japan, there is a report made by Tokunaga and Odagaki (1939), however, it lacks observations on the second and the fourth instar larva, and further more the authors ambiguously assumed that the total larval period might be five or six years, and there might be the case of seven or eight years required for emergence.

The author examined mountain streams in Hitoyoshi City and Kuma-gun, Kumamoto Pref. since 1968, and checked the distribution of the species there. Along with observing larval development in nature, The author reared the larvae and could observe all the stages of *E. superstes* from oviposition, hatching, each instar period to emergence. Here Author reports on the life history of the larva.

For rearing larvae, each instar larvae of 1-5th instar was reared in a petri dish of 6 cm in diameter, in which

fragments of rotten woods and fallen leaves from streams were put, respectively. They were fed with water fleas. Larvae, older than sixth instar, were reared in tupperwares (10*8*4 cm) with pebbles inside. They were fed with larvae of midge, *Chironomus*. Rearing temperature was kept 5-15°C.

The author observed the larval development always in comparison with those in nature (4742 larvae were collected from streams). The result of the instars (total observation of ecdyses of 978) is described.

1. Larval habitat

The common environment for larval habitat is a dark stream in a hill covered thickly with trees of primeval forest, and its stream bed is less muddy, composed by sand and pebbles. Due to scanty flow of water, the water temperature was 4 to 5°C in winter and 16-17°C in summer.

Most of younger instar larvae of 1-5th instar hid under fragments of rotten woods or dead leaves of the bottom of streams at shallows. Larvae of older than sixth instar hid underside of stones clinging to it upside down.

2. Habits of larvae

Larvae moved chiefly by walking and jet propulsion by jetting water from rectum was never sighted. They exhibited negative phototaxis, and in the daytime, younger instar larvae of 1-5th instar stayed under rotten woods or dead leaves of the bottom of streams and the larvae older than seventh instar stayed under stones. The sixth instar larvae seemed to be in transition, and both types of staying were found. Larvae were active in the night. Cannibalism of the larvae was not sighted, and two or three larvae were found staying under the same stone. They are carnivorous, and preyed on small aquatic animals. When a prey approached, a larva turned its body toward the prey, lifted itself a little, then caught the prey extending quickly the labium that was folded under its head to it. When the larva was touched or it sensed danger, it walked away quickly or showed thanatosis by shrinking legs, and in case of a young larva, it floated and flew on the water with its legs spread. Grown larvae sounded fricatives by swinging their bodies from side to side when they were caught.

3. Stadium number of the larva

It was confirmed by my observation on the ecdyses of the reared larvae that the whole larval period was made of 14 instars. The growth curve was shown as an equation, $Y = a(1+r)^{X-1}$, which coincided with that by Tokunaga and Odagaki (1939). Y shows body length at X of stadium, and a is the body length of the first instar, and r is the ratio of body length of post ecdysis to pre ecdysis, and it was ca. 0.24.

4. Morphology of each instar larva

Morphology of each instar larva is shown in Fig. 1-14, and only conspicuous characteristics are shown in

Table 3. It was extremely difficult to rear such larvae that inhabit special environment through the whole larval period on the same larva, and only one was reared for the longest for succeeding seven stadia from 6th to 14th, and most cases were 2 to 3 succeeding stadia. Even in the same stadium, the development widely varied by rearing condition (environmental), and The author examined them by comparing the stadia of rearing larvae with those of larvae in nature. The author described the stadia of the larvae that developed most normally.

5. Larval period

According to each stadium and ecdysis of larvae and the fluctuations of larvae in nature, it was found that the whole larval period was composed by the following types.

a. Five years type: the larva of this type develops so early, and emerges in sixth year (see Table 1).

b. Six years type: normal type that develops smoothly, and emerges in seventh year, and most of larvae belong to this type (Table 2).

c. Seven to eight years type: the development is not smooth and the larvae grow lately, and it takes one year for the ninth to twelfth larvae to finish one stadium. They emerge in eighth or ninth year.

Table 3 shows the morphology and days of stadium of each stadium of the larvae.

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References

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Table 1. The stadia and the date of ecdyses of the five years type larvae. /:partition of years.

Stadium	Prolarva	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Emergence
A indiv.	VI-14	VI-14	VII-9	X-10/	III-28	VI-20	IX-3	XII-2/	IV-23	VIII-2	X-31/	I-8	IV-20	VIII-30/	VII-10/	IV-7
B indiv.	VI-16	VI-16	VIII-2	IX-27	XI-29/	II-3	IV-14	VII-9	X-22/	IV-22	VII-19	XI-5/	VII-10	XI-25/	VII-19/	IV-5

Table 2. The stadia and the date of ecdyses of the six years type larvae.

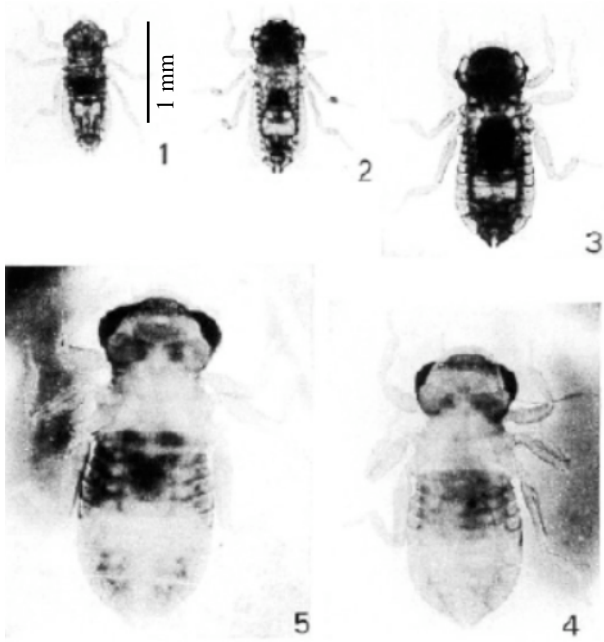
Stadium	Prolarva	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Emergence
A indiv.	VI-16	VI-16	VIII-11	X-6/	II-3	IV-27	VII-23	X-21/	III-14	VII-12	XI-21/	VI-28	XII-1/	IX-5/	VII-2/	IV-16
B indiv.	VI-16	VI-16	VIII-11	X-6	XII-7/	IV-9	VII-5	X-3/	II-21	VI-24	XI-3/	VI-10	XI-13/	VIII-18/	VI-16/	III-31

Table 3. Larval development of *Epiophlebia superstes* Selys.

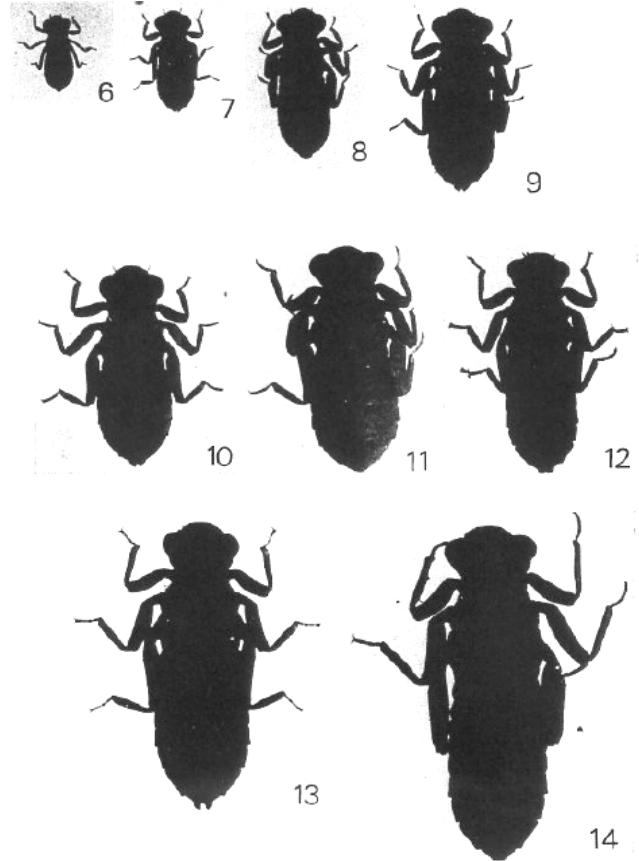
Stadium	Body length (mm)	Body coloration	Denticles of median lobe of labium		Segments of antenna	Tarsal segments
			Anterior margin	Inner margin		
1	1.2	White and hyaline	0	8	3	1
2	1.4	Pinky white and hyaline	5±	8	3	1
3	1.7	Light yellow and hyaline	7	10	3	2
4	2.1	Milky light yellow and spots on abdomen	9	11	3	2
5	2.6	<i>do.</i>	11	12	3	2
6	3.3	Yellowish white with dark spots on abdomen	14	14	3	2
7	4.2	<i>do.</i>	20	16	4	Fore leg 2 mid and hind leg 3
8	5.7	<i>do.</i> but some black	24	18	4	3
9	7.3	<i>do.</i> but some black or redish brown	28	18	4	3
10	9.0	<i>do.</i> some black, redish brown and green	30 ₍₁₎	18	5	3
11	10.1	<i>do.</i>	38 ₍₂₎	20	5	3
12	12.6	<i>do.</i>	44 ₍₃₎	20	5	3
13	15.5	<i>do.</i> few spotted	54	22	5	3
14	19.5	black	70	22	5	3

Stadium	Wing-sheath	Files on abdomen	Duration of stadium		Habitat environment
			days ₍₄₎	days ₍₅₎	
1	-	-	ca. 56	-	Under rotten woods or dead leaves at shoals
2	-	-	56	-	<i>do.</i>
3	-	-	63	ca. 120	<i>do.</i>
4	-	-	83	123	<i>do.</i>
5	-	-	87	124	<i>do.</i>
6	-	3-7th abdominal segments	90	128	Cling to the underside of stones
7	±	4-7th abdominal segments	107	141	<i>do.</i>
8	+	<i>do.</i>	123	175	<i>do.</i>
9	reach 2/3 of thorax	<i>do.</i>	132	198	<i>do.</i>
10	reach anterior margin of abdomen	<i>do.</i>	147	219	<i>do.</i>
11	2/5 of 1st segment of abdomen	<i>do.</i>	156	254	<i>do.</i>
12	a half of 1st segment	<i>do.</i>	173	278	<i>do.</i>
13	posterior margin of 2nd segment	<i>do.</i>	190	302	<i>do.</i>
14	posterior margin of 4th segment	<i>do.</i>	-	288	<i>Landing in early February and hides under pebbles and dead leaves on the water edge.</i>

(1) Setae between denticles begin to change into strong setae. (2) Halfly strong setae. (3) all strong setae. (4) Days of not overwintered. stadium. (5) Days of overwintered stadium.



Figs. 1-5. Photomicrographs of larvae of *Epiophlebia superstes* from Kyushu.
 1: 1st instar larva, 2: 2nd instar, 3: 3rd instar, 4: 4th instar, 5: 5th instar.



Figs. 6-14. Photomicrographs of larvae of *Epiophlebia superstes* from Kyushu.
 6: 6th instar larva, 7: 7th instar, 8: 8th instar, 9: 9th instar, 10: 10th instar, 11: 11th instar, 12: 12th instar, 13: 13th instar, 14: 14th instar.