Digest of Japanese Odonatological Short Communications

edited and translated by

ISHIZAWA,Naoya

1644-15, Yamaguchi, Tokorozawa City, Saitama Pref., 359-1145, Japan

Yosegaki, 122 (2006) : 61-65

Crawling of *Epiophlebia superstes* larvae on the snow

Kano, Kazunobu[1] & Toshihiro Miyahata[2]

5-19-17-601 Koishikawa, Bunkyo-ku, Tokyo, 112-002, JAPAN

35-2 Hakoda-cho, Maebashi City, Gunma Pref., 371-0837, JAPAN

Introduction

Epiophlebia superstes are the first dragonflies to appear in spring in the Kanto Region. I often visited streams on Okutama and Hanzono Valleys to find larvae of this dragonfly in early April, but I rarely saw them. It is known that the larvae live in streams seven or eight years, and after landing they stay on the land for about 30 days. I observed the lavae on two occasions: I found the larvae under stones near the banks of streams in Okutama at the end of March, and I also saw them moving around on moss-covered rocks on the banks of streams in Hanazono Valley at the end of April, but these are rare cases.

After hearing the presentation by Naraoka, H and K. Takahashi at the general meeting of the Japanese Society for Odonatology on October 1 2005, that *E. superstes* larvae crawl on the snow in Aomori Prefecture. I went there to see them with Miyahata. We reached Nurukawa, at Hirakawa City, Aomori Pref. at 8:00 a.m. on April 22 2006, and observed the landing of the dragonflies from 9:00 a.m. to 2:00 p.m. We also videotaped and photographed the dragonflies landing.

Environment: The landing site (Fig. 2) is located at a small branch stream, which flows south to north the Nurukawa River, the width of the stream was 2-3 m, gently slanted, and at both sides beeches grew sparsely. We observed snow which had melted around the trees, depressions around the roots, and dead leaves. We walked searching for larvae on the snow along the stream for a distance of 350m.

Weather : It was cloudy and 2℃ until 10:00 a.m., and thereafter the sun shone on the stream, and it became clear, ambient temperature was 8℃, and the stream became swollen as time advanced.

Fig. 2 Snow-covered stream at Nurukawa, Aomori Pref. on 22 Apr. 2006.

Behaviour of larvae: Four larvae landed at 9:00 a.m. At 10:00 a.m. when the sun shone on the stream, larvae landed one after another, with a total of 32 larvae having landed by 2:00 p.m. According to Mr. Naraoka, who had been investigating the larvae since early April, the number of them that landed that day was the largest number observed on one day, probably due to the fine weather. The farthest distance the larvae crawled from the stream was 10m, and most of them seemed to reach the depressions around the tree roots.

I sighted a larva entering a depression only one time. Another larva once entered a depression six meters away from the bank site, but it came out and climbed up the snow covered slope. The larvae climbed the overhanging wall of snow easily, however, some fell into the stream from the over wall and tried again (observers: Naraoka and Miyahata).

The larvae were sensitive to the sun and showed an inclination for landing on the western bank, the ratio of landing on the western versus the eastern bank was 7:3. When they landed on the eastern slope and their dorsal side was exposed to the sun, they changed course toward the west so their backs would be in the sun. According to Naraoka, when the dorsal side of the larvae is exposed to the sun, the position in front of the larvae is light, and the larvae can orient itself toward the light. Another hypothesis (Ishizawa personal comment) is also possible: that such orientation to the sun is for thermoregulation.

When I covered a larvae with a vinyl umbrella to adjust the exposure for a photograph, the larvae could not orient itself and stopped crawling, but when the

Fig. 3 Crawling larva, 20 m apart from the stream at Nurukawa, Aomori Pref. on 22 Apr.

umbrella was removed it continued crawling in its original direction.

The larvae's crawling speed was measured on two specimens: their speed was 20 cm/min., which was rather fast. Two larvae crawled a distance of 3m in 15 min., resting two times on a slanted slope of snow. According to Naraoka and Takahashi's observations, the larvae's speed was 1〜66cm/min., which is faster than their 1.1cm/min. speed on the moss-covered area in Hanazono Valley where there is no snowfall. Their crawling speed on the snow was unexpectedly fast with one larvae crawling at the speed of 60 cm/min. The larvae crawled rhythmically with their body away from the surface of the snow.

My perspective: In the Kanto Region larvae that crawl on the ground or dead leaves cannot be easily seen. Our observation of the larvae crawling on the snow is significant for confirming the behavioural diversity of the larvae. Their behaviour on the snow seems to be different from that on the bare ground. It may be necessary for them to crawl quickly on the snow, because they can be easily found by predators. There may be another mode of crawling behaviour for the larvae of regions without snow, and I expect to further study this question.

E. superstes larvae are distributed from Kagoshima in Kyushu up through Honshu and further north in Hokkaido. Their emergence period starts early in March, however in Hokkaido it can be seen in June. In snowy regions, the larvae must land on the snow.

According to Naraoka the emergence site there has not yet been found, while in Kanto region it was located ca. 10m away from streams: in the Okutama valley it is closer to the streams. In the snowy region, the ground was snow-covered far away from the streams, and the larvae moved straight to the depressions. After the snow melts, the larvae may move so that their emergence site is farther away from the streams.

I wonder why it is necessary for the larvae to land on the snow in such difficult conditions. I was deeply impressed with their crawling on the snow.

References have been omitted by editor.

GEKKAN-MUSHI, No. 279 (1994): 18-21.

Diurnal rhythm of the damselfly, *Ischnura asiatic* Brauer (Coenagrionidae, Odonata) (2) Sperm displacement

Naraoka, Hirozi

36-71 Motoizumi, Fukunoda, Kita-tsugaru-gun, Aomori Pref., 038-3661, JAPAN

I described the diurnal activity and reproductive behaviour in the first report (Naraoka, 1989) on the adult of *Ischnura asiatica* Brauer. Here I report on sperm displacement of the damselfly.

Sperm displacement is one of the selfish behaviours for enhance male fitness that in insects which engage in multiple copulation a mate male removes sperms which a female received from a previous mate male from bursa copulatorix of the female or push them into it, thereafter the mate male puts its own sperm into it for the advantageous insemination by its own sperms.

Sperm displacement was for the first time reported by Waage (1979) on *Calopteryx maculata*, and thereafter many reports have been made on Odonata; *Enallagma cyathigerum* (Miller & Miller, 1981), *Lestes vigilax* (Waage, 1982), *E. hageni* (Fincke, 1984), *Erythemis simplicollis* (McVey & Smittle, 1984), *Cercion sieboldii*, Naraoka, 1986), *Orthetrum canthellatum*, Siva-Jothy, 1987), *Mnais pruinosa pruinosa* (Tsubaki, 1988), and it

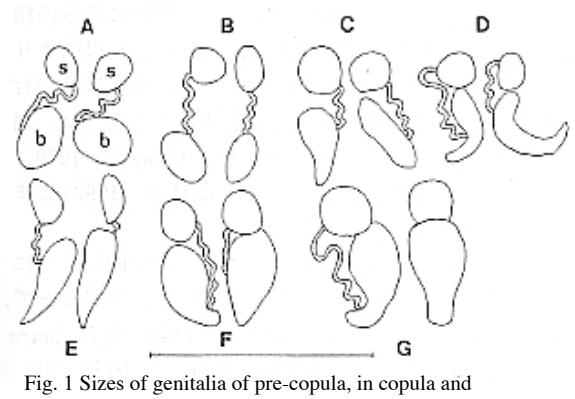

Fig. 1 Sizes of genitalia of pre-copula, in copula and post-copula in *Ischnura asiatica*.
A: pre-copula, B: fore part at stage I, C: Middle part of stage I, D: post stage I, E: post stage II, F: post stage III (specimens of August and September), G: same stage of July b: bursa copulatrix, s: spermatheca, scale: 1 mm. Right: lateral view, left: flat view, upper: backward, below: forward.

is considered common among Odonata, especially in zygoptera (Waage, 1986).

The reproductive behaviour of *Ischnura asiatica* is similar to those in the above-mentioned *E. cyathigerum* and *C. sieboldii*, and sperm displacement may be also conducted. I examined the behaviour based on the situation of bursa copulatorix of females that were engaged in copulation. Here I show the sperm displacement of the damselfly.

METHOD

Materials were collected at Byobu-san, Kizukuri-machi, Nishi-tsugaru-gun, Aomori Pref from July to September. There scatter many bogs and marshes edged with grass fields on the seashore of the Japan Sea, and these sites many *I. asiatica* inhabited and reproductive activities were very often sighted. Copulating pairs were captured carefully and they were put in a cylindrical cage, of which diameter was 15 cm, height, 25 cm, covered with a mesh net (mesh size, 1.5 mm). At the finish of each stage of copulation the pairs were forced to separate and were folded in triangular paper and were brought back to my home. Early in the morning also I collected mature females and females on the way of the first stage of copulation.

I desected these females through a streoscope and verified the volumes of bursa copulatorix and spermatheca and copied the volumes by a drawing device of Abbe. Each organs swelled so much that the largest volume organ was regarded 100 (see post stage III of specimens collected in July), then relative volumes were caluculated and regarded the swell by the standard.

The volume of swell was divided into four classes; empty (swell 20%), medium (swell 50%), swelling well (swell 80%), fully swell (swell 100%). The value is relative therefore, precise volume is not clear. I did not examin vescle of males. Data were tested with *F*-test of analysis of variance.

RESULTS

Fig. 1 and Table I show the results of observation of bursa copulatrix and spermatheca. Bursa copulatrix of *I. asiatica* is comma-shaped and located inner part of vagina. spermatheca is round and located at the tip of a tube curved zigzag, connected to bursa copulatrix, the size as that of one third of the latter.

Genitalia is generally dark brown, however, in full size those were milky white. The swell was equal in bursa copulatrix and spermatheca, but some cases the swell of spermatheca was larger, and except for pre-copulation and post stage II, the swell was larger in spermatheca was larger than bursa copulatrix (Table I). But in every case there was no significant difference between them (P>0.05).

(1) Females captured early in the morning

Eight single mature females captured at 8:00 a.m. were examined. Their genitalia were dark brown. Both bursa copulatrix and spermatheca were small, but rather swelled and those were not empty and loose, and the swell was 54% in average of their full volumes.

(2) Females at stage I

Females at stage I of copulation were captured at 8-8:30 a.m. (16♀) and 9-9:30 a.m. (24♀) at the site.

Copulation of *I asiatica* starts at 6:00 a.m. and usually takes 4-5 hours (Naraoka, 1989), so that at the longest 2 hours might have passed since they started copulation in the group captured at 8:00 a.m. and 3 hours in the group captured at 9:00 a.m. Hence, the duration of copulation might be longer in the latter than in the former.

The result showed no significant difference between those (F=0.93, P>0.5), and the genitalia were dark brown. The swell were 31% in average of bursa copulatrix and spermatheca 43% in 8:00 a.m. group, and in 9:00 group, 31%, 36%, respectably.

(3) Females at post stage I

13 females of soon after stage I were examined. Genitalia were dark brown and most of those were small and got deflated. The average swell was 29% on bursa copulatrix and 39% on spermatheca, and the difference between those was not significant (F=2.53, P>0.05).

(4) Females at post stage II

17 females of soon after stage II were examined. Those were not so changed from those at the post stage

I, and genitalia were dark brown and the swell was various, from flat to rather swollen, and two were 80% of the swell. The average swell was 38% of bursa copulatrix and 38% of spermatheca. The former was significantly larger than at the stage than at stage I ($F=4.7$, $P<0.05$), and the latter was the same volume.

(5) Females at post stage III

18 females of soon after stage III were examined. The swell varied by examined period. In females (4 specimens) captured in July both bursa copulatrix and spermatheca were full volume (100% of swell) and milky white. While in those captured in August and September, the swell was 80%, and only one of 20% of swell was observed (Table I). Thus, the genitalia at this stage was swelled more than those of single females and females at stage I or stage II. Some of the genitalia were dark brown and some were milky white. The swell was 81% on bursa copulatrix and 84% on spermatheca.

DISCUSSION

Bursa copulatrix of *I. asiatica* is comma-shaped and located inner part of vagina. spermatheca is round and located at the tip of a tube curved zigzag, connected to bursa copulatrix, the size as that of one third of the latter(Fig. 1). The shape is the same ass those of *E. cyathigerum* (Miller & miller, 1981) and *I. ruforstigma* (Srivastava & Srivastava, 1992).

The volume of genitalia of *I. asiatica* varied by the stage, pre-copulation, copulating and post copulation. Also, bursa copulatrix and spermatheca varied at each stage as follows;

Bursa copulatrix

Post stage III>**pre-copulation>post stage II>post stage I

Spermatheca

Post stage III>**pre-copulation>*post stage I≒ post stage II

(**: $P<0.01$, *: $P<0.05$)

The volumes of both bursa copulatrix and spermatheca were smallest at stage I (the former, 29.2; the latter, 38.5%). Next was medium size in the females of pre-copulation (53.8%, 53.8%). The largest was post stage III (81.1%, 84.4%) with full size and well swelled. Genitalia of pre-copulatory females deflated seemingly due to expenditure of sperms for oviposition (both 54% in bursa copulatrix and spermatheca). Genitalia at post stage II was not so different from that at stage I, and at the stage sperm displacement doesn't seem to be engaged. Then, the changes of the genitalia may be explained as follows; the deflation from medium size of genitalia at post-stage I is the result of remove from it by mate male of sperm that was stored by former copulation. After that the mate male transfered its own sperm to the female during stage III, and the genitalia swelled more than at previous stage. That is to say, sperm displacement was conducted. This change of the genitalia is the same as those reported on sperm displacement of other damselflies (Waage, 1979; Fincke, 1984; Cordero & Miller, 1992).

The changes of the swell of bursa copulatrix and spermatheca at each stage were the same as seen in *Orthetrum coerulescens* (Miller, 1990) and *I. graellsii* (Cordero & Miller, 1992), and in this case sperms seem to be removed not only from bursa copulatrix but also from spermatheca; this is different from those in many other Odonata. However, the thin tube connected to spermatheca of *I. asiatica* is zigzagged, while to the tip of the penis of male a pair of horn attaches (Ando, 1962), and its length is the same as the tube and is thin enough. But it is seemingly not suitable to scratch and remove sperms from spermatheca through the tube. Change of pressure in bursa copulatrix may suck sperms out from spermatheca.

According to Miller & Miller (1981), males of *E. cyathigerum* remove sperms from females by up and down abdominal movement at stage I and transfer their sperms to females at stage II and III by pumping. Tsubaki (1988) noted that in *M, p. pruinosa* remove of sperms was conducted at stage I and transfer of sperms

Table I

Swell(%) of genitalia of *Ischnura asiatica* at pre-copula, in copula and post copula

	July					Aug. + Sep.					Total				
	B			S		B			S		B			S	
	n	x	(R)	x	(R)	n	x	(R)	x	(R)	n	x	(R)	x	(R)
Pre-copula	5	56.0	(50-80)	56.0	(50-80)	3	50.0	(-)	50.0	(-)	8	53.8	(50-80)	53.8	(50-80)
Copula 2 h	-	-	-	-	-	16	31.3	(20-50)	42.5	(20-80)	16	31.3	(20-50)	42.5	(20-80)
Copula 3 h	12	27.5	(20-50)	27.5	(20-50)	12	35.0	(20-80)	45.0	(20-80)	24	31.3	(20-80)	36.3	(20-80)
Post sage I	5	38.0	(20-50)	38.0	(20-50)	8	23.8	(20-50)	38.8	(20-50)	13	29.2	(20-50)	38.5	(20-50)
Post stage II	5	44.0	(20-80)	44.0	(20-80)	12	35.0	(20-80)	35.0	(20-80)	17	37.6	(20-80)	37.6	(20-80)
Post stage III (Finish of copulation)	4	100.0	-	100.0	-	14	75.7	(20-80)	80.0	-	18	81.1	(20-100)	84.4	(80-100)

B: bursa copulatrix, S: spermatheca, n: number, x: average, (R): range.

Table II
Changes of volume of genitalia in copula of damselflies

Species	Stage I	Stage II	Stage III	References
Calopteryx maculata	-	-	+	Waage '79
Mnais p. pruinosa	-	.....	+	Tsubaki '89
Lestes vigilax	-	-	+	Waage '82
Ischnura asiatica	-	.....	+	This report
I. elegans	-	+	.....	Miller '87b
I. graellsii	-	+	.....	Cordero & Miller '92
Cercion sieboldii	-	+	.....	Naraoka '86
Enallagma cyathigerum	-	+	.....	Perry & Miller '92

- decrease, + increase, ... not changed

was done at stage III, and in *I. asiatica* the process may be the same.

In *C. sieboldii* (Naraoka, 1986) sperms were transfered to females at stage II, and no change of volume of sperm in female at stage III, which lacks pumping, was seen. Movement of males in copula of *I. asiatica* is fundamentally the same as that of *C. sieboldii* (Naraoka, unpublished). However, genitalia of females at post stage II was not changed from stage I (Table I), and this is the same case as in *M. p. pruinosa* which lacks pumping at stage II (Tsubaki, 1988). Cordero & Miller described of no relation of frequency number of pumping to quantity of sperm ejaculation in *I. graellsii*. Thus, whether transfer of sperm at stage II is conducted or not varies by the species (Table II).

Duration of copulation in *I. asiatica* is so long (2:30-6:40 hours) and it shares most of stage I (2.20-6:30), amounting 91.4% of the total duration (Naraoka, 1989). Examination of genitalia at the fore part of stage I (within ca. 2 hours) and middle part of the stage (within 3 hours) showed no difference of the swell between both stages. This suggests that sperms are removed at the fore part of stage I. Thereafter, in spite of pumping was seen, volume of genitalia is not changed. Also, Miller (1987a) noted that remove of sperm was conducted at the fore part of stage I.

Volume of genitalia at post stage III (finish of copulation) varied by the period. Those in July were fully swollen, filled with contents, while it was 80% from August onward (Table I). Because of scanty data, further study is necessary.

References are omitted by editor.

Yosegaki, 122 (2006) : 68-69

Some notes on dragonflies at HongKong

Kano, Kazunobu

5-19-17-601 Koishikawa, Bunkyo-ku, Tokyo, 112-002, JAPAN

I participated in the 17th International Symposium of Odonatology in Hong Kong, S.I.O, from July 31 to August 5 2006. In spare moments away from the meeting, I observed the ecology of dragonflies there, and here I report on them.

1. Intramale sperm translocation of *Euphaea decorate*
I observed its copulative behaviour in a small stream at Sha Lo Tung, where there was a deserted village on hill. I and Mr. Inoue, a representative of S.I.O. observed the coupulation from midway on, and the pair separated after two minutes. Afterwards, the male was not interested in its female partner, and soon started intra-male sperm translocation and finished within a few seconds.

2. Dragonflies responded to a rotating object
On August 1 and 2, we (N. Ishizawa, and I) tested his rotating dummy on some dragonflies to ascertain how dragonflies respond to the device. Two species responded to it, one of which was *Ictinogomphus pertinax*: two males at Wetland Park reacted strongly to the dummy (see Photo 2) and often the two faced each other with the dummy between them. The two *I. pertinax* males indicated a strong interest in the dummy.

On August 2 we tested this device on an *Orthetrum Iuzonicum* male. When the dummy was put in front of it, the male approached it and hovered, but the reaction was not so strong.

3. Territorial behaviour of some dragonflies on a wet asphalt road

Four of us, Watanabe, K., Karube, H., Ugai, S., and I, visited Lu Keng in Hong Kong. The road surface was

Photo 2. Reacting *Ictinogomphus pertinax* males (arrows) to the dummy (☆)

wet due to a recent typhoon and the wind was still blowing. I was interested in the dragonflies flying over the wet asphalt road. I had seen such dragonflies in Japan, and this time I observed two species.

The wet asphalt road, which was a narrow farm road with grasses growing on both sides, looked like a stream under the cloudy sky. At an interval of 150 m I saw two males of *Brachythemis contaminate* and one male of *Orthetrum sabina sabina* holding their territories. When I chased them to take photographs, they only flew further away along the road, but never left it.

4. Some rare dragonflies in hong kong

We visited Luk Keng guided by Mr. Ugai, on the morning of August 5, and observed two rare species *Nannophyopsis clara*, which I remember appeared in ' Hong Kong Dragonflies' written by K. D. P. Wilson and *O. pocilops miyajimaensis*. A photo of Mr. Ugai picking up the wings of *N.clara* appeared in the book and was the first record of the species from Hong Kong. I heard that he at first regarded it as a species of *Tetrathemis*, however Mr. Wilson later informed him that it was *N.clara*.

It was unexpectedly small. Its body size was less than 2 cm, and it was a dull metallic green with green compound eyes. The abdominal tip was wide and peculiarly shaped, and the body colour seemed to be similar to a *Somatochlora* of the same size the *Nannophya pygmaea* species. Two species of the genus is known in the world; *N. clara* inhabits Taiwan and Hong Kong, and *N. chalcosoma* Indonesia and Borneo. I saw *N. clara* at small pools in a bog where streams flowed. One male had its territory at a small pool on the side of a narrow path. I took a few photographs of it , but it was so small and the humidity was so high that I could hardly focus on it.

At the bog I also saw some other dragonflies: two males of *Trithemis aurora*, one male and one female of *Neurothemis tullia tullia* , and two males of *N.clara*.

On my way back I visited a site of *O. miyajimaensis*. I was luckily able to photograph one male of the species perched in a field of reeds in the strong wind. The reed field was located near brackish water adjacent to Mangrove bushes, so the dragonfly was observed in a limited environment.

I could not find *Mortnagrion hirosei*, because there was not enough time. However, later I heard that Karube and Ugai sighted a few of them there, but they were not abundant.

I express my thanks to S. I. O. representative Inoue for his suggestion, to Mr. Ishizawa for showing us his experiments with the rotating device on dragonflies, and the above-mentioned members for their useful information, especially to Mr. Ugai for being an excellent guide in those areas.

References

Kano,K., 2005. Single sperm translocation of a Coeliccia ryukyuensis amamii male. Boso no Konntyu, No.35(2005):52

Ishizawa,N.& Y. Arai, 2003. The response to rotating objects by Anotogaster sieboldii (selys) male (Anisoptera: Cordulegastridae). Odonatologica 32(1): 19-28

Kano,K., 2005. Reproductive behaviour of dragonflies over a wet asphalt road on Amami-ohshina Island. Yosegaki, 118: 62-64

K. D. P. Wilson, 1995. Hong Kong Dragonflies An Urban Council Publication, p.145

Photo 3. *Nannophyopsis clara male* perching at its territory. Photographed by Mr. Ugai.

Editor's notice: As to the landing on the snow by larvae of *Epiophlebia superstes*, Mr. Naraoka is contributing a precise report to the next issue of Tombo, the bulletin of The Japanese Society for Odonatology.