



Biology of *Hypsopygia postflava* (Lepidoptera: Pyralidae), a Snout Moth Parasitic on the Nest of the Paper wasp *Polistes olivaceus* (Vespidae: Polistes)

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ABSTRACT: *Hypsopygia postflava*, a snout moth parasitic on the nest of the paper wasp *Polistes olivaceus* was reported first time, with studies on its biology. Head width of moth larvae from third instar and over was difficult to specify because of great variety. The duration of life cycle of *H. postflava* was 40.46 ± 4.96 days, ranging from 33 to 49 days. Life time of both female adult and male adult was equal (in the 6-9 day range). Survivorship ratio was, for larvae 88%, and for pupae 82.5%. Sex ratio of *H. postflava* in laboratory experiments (:) was 1: 1.26 in comparison with 1: 1.55 of that of adult moths emerged from the nest of the paper wasp *P. olivaceus*. The average number of eggs having in the body of the female adult was 88.93. However female adults only laid a mean of 39.39 eggs during their lifetime. Female adults laid eggs singly or in clumps of a few eggs. The mean ratio of hatched eggs was very low (18.98%).

Key words: *Hypsopygia*, Lepidoptera, lifetime, paper wasp, Pyralidae, snout moth

INTRODUCTION

Accidentally, on March 22, 2014 when I was concentrating on my study on the hibernation of the paper wasp, *Polistes olivaceus* (Pham, 2014), with field trips in Hanoi, I collected a nest of this wasp that it had strangeness in comparison with any nest which had been collected before. I decided to scrutinize the nest.

On April 12, some adult moths emerged. It made me though whether this was one of moths parasitic on the nest of the paper wasp. I had decided to send specimens of the moth to a colleague of mine in Russian and then he informed me that this was a snout moth parasitic on the nest of the paper wasps, with its scientific name *Hypsopygia postflava* (Hampson, 1893).

H. postflava is one of the snout moths belonging to the family Pyralidae, the order Lepidoptera. To date, in the world, studies on biology, habit or bionomics of the species have been only produced in Japan by Nakatani *et al.*, (1999) with its parasite on the nest of *Polistes jadwigae*, and by Kato *et al.*, (2007a,b) with its parasite on the nest of *Polistes jokahamae*. Those studies are about the life cycle, hibernation, mating, oviposition, and prey use by larvae of the species. Thus *H. postflava* is yet poorly studied.

In Vietnam, to now, studies on taxonomy, biology, or bionomic of *H. postflava* belonging to family Pyralidae are yet very poor and still very lack of documents. However, so far I have not yet had a sufficiency of documents to certify that the snout moth *H. postflava* is a new record for Vietnam. With discovery of the pupae, and of emergence of adults on the nest of the paper wasp *P. olivaceus*, the

present paper is to record its first parasite on the nest of the paper wasp *P. olivaceus*, with studies on its biology.

MATERIALS AND METHODS

A nest of the paper wasp *P. olivaceus* collected at Nghia Do precinct, Cau Giay district, Hanoi, Vietnam (21°03' 41.2" N, 105°47' 24.8" S, altitude 17m). The nest was attached to the roof of a desolate house at an uncultivated field, with a height of 2.5m from the ground.

All cells of the nest were particularly observed, and marked with cells which have the present of moth cocoons. In conditional laboratory, emerged adult moths were reared in non-toxic plastic jars (20 cm diameter × 12 cm height) by the honey of 50% in concentration. Moth larvae were also reared in non-toxic plastic jars (10 cm diameter × 8 cm height) with a number of 5 individuals/jar by larvae and pupae of the rice moth *Corcyra cephalonica*. The humidity was, in non-plastic jars, made by the absorbent cotton. The shelter of moth larvae and moth pupae was with the cells of the nest of the paper wasp *P. olivaceus*. Adult female and adult male moths were geminated immediately after they emerged. The examination was taken every day with a frequency of 2 times/day (9 am and 15 pm). Head width of moth larvae were made with the ocular micrometer attached to a stereoscopic dissecting microscope. The temperature and the humidity in the laboratory were automatically marked by a Humidity and Temperature Recorder, Extech RH520. Pictures were taken by a digital camera Canon SD3500 IS.

RESULTS AND DISCUSSION

A total of 34 nests of the paper wasp *P. olivaceus* collected from the beginning of January to the end of March in 2012 and 2014, only the one had the present of the snout moth *H. postflava* (Fig. 1a). In the world, this moth only discovered in Japan, with its parasitism

on the nest of paper wasp *P. jadvigae* (Nakatani and Yamamoto, 1999) and *P. jokahamae* (Kato, Yamada, Matsuura and Tsukada, 2007a, b). This paper is thus the first record for parasitism of *H. postflava* on the nest of the paper wasp *P. olivaceus*.

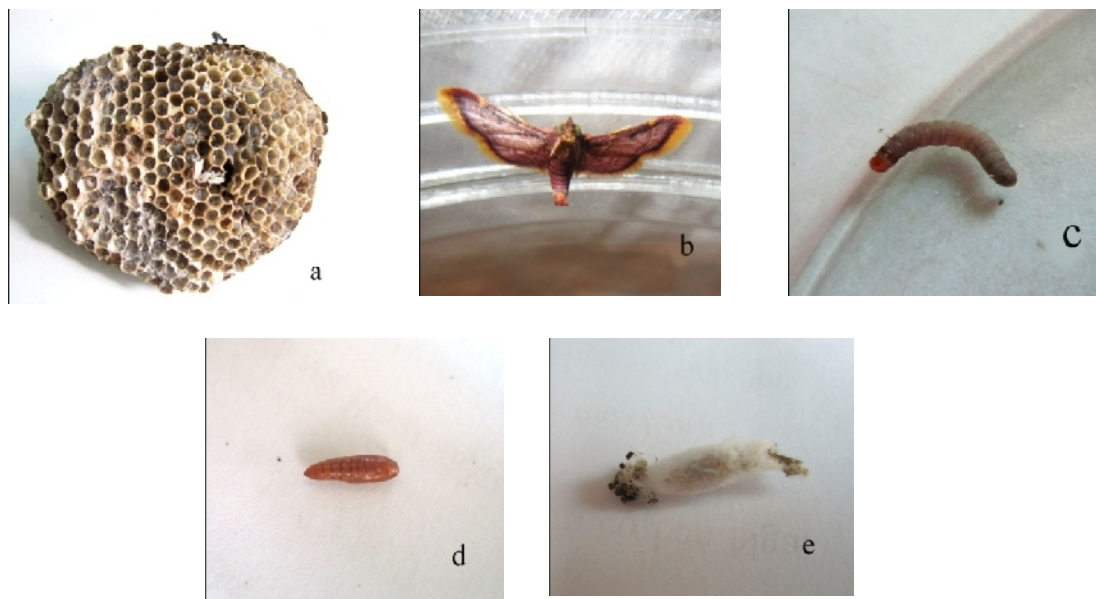


Fig. 1. a) The nest of the paper wasp *P. olivaceus* parasitized by *H. postflava*, with the silks on the surface of the nest; b) Adult female moth; c) Moth larva; d and e) Moth pupa.

The nest of *P. olivaceus* was with 437 cells, 8 cm in height, 14 cm of the diameter, and 1.1 cm in length of the eccentric peduncle. Of those cells, 25 contained moth cocoons. In the duration of 9 days from 12 to 20 April, 2014, a total of 23 adult moths emerged from the nest of *P. olivaceus*. Of these, 9 were females and 14 were males. Thus sex ratio of this moth (:) was 1:1.55, and survivorship ratio of pupae was 92% ((23:25)*100). Adult moths emerge on the beginning of the summer. It suggests that moth pupae overwintered on the nest of the paper wasp *P. olivaceus*. Reasons for that: 1) Scarce food resources. Because, if moth adults emerge in the duration from October to March of next year, it is very difficult for them to find the nest of *P. olivaceus* which contains larvae or pupae to lay eggs into or near. In this duration, mated females of the paper wasp *P. olivaceus* are hibernating (Pham, 2014). Or in other words, new nests of this wasp are not built in this duration 2) Severe weather conditions. Because this is the winter period (October - March), and an average temperature is under 15°C in Northern Vietnam.

Head width of moth larvae showed in Fig. 2. According to this data, head width of first instar larva was 0.2-0.22 mm, and of second instar larva 0.3-0.4 mm. However, that of third instar larvae and over was very difficult to determine due to great

variation (from 0.4 to 1.4 mm). Kato *et al*, 2007 stated that the head width of overwintering moth larvae varied greatly between the nests and also within some of the nests, and the authors did not determine any age of the moth larvae. Thus results examined here only define the age of first instar and second instar moth larvae.

The duration of the life cycle of *H. postflava* was variable, from 33 to 49 days, and the total mean duration was 40.46±4.96 days (Table 1). Of these, eggs 5.72±1.23 days, larvae 22.03±1.75 days, pupae 8.33±0.99 days, before laying 4.38±1.02 days. The duration of immature stages of *H. postflava* (first generation) provided with pupae of the paper wasp *P. jokahamae* in Japan are: egg 8.1±0.8 days, larva 23.6±1.8 days, pupa 11.4±0.9 days, and life cycle 56.4±11.7 days (Kato *et al*. 2007). The difference between two these study results is due to some ecological features like local climate and food available, which could affect every immature stage development, the pupal stage is very similar to that in their study result. Newly hatched larvae are almost no displacement, 4-5 hours then they move and forage the food resources. Larvae ate each other when deficiency food or greatly individual density (10 individuals/jar and over) without eating eggs, and often spin the silk to fix the shelter with the plastic jar.

Mature larvae spin the silk cocoon before they are of the formation of pupae. Moth larvae usually hide in the shelter except for foraging the food. This is one of the basic and important habits of this snout moth. Because, with this habit, larvae will escape the attack of wasps or of other natural enemies. Life time of both female moth and male moth was very similar,

variable from 6 to 9 days, an average 7.76 ± 1.04 days to females, and 7.51 ± 1.03 days to males. Most of female moths died after laying egg (about 10-12 hours). With adding on this datum, life-span of the snout moth varied from 37 to 53 days. Thus it is considered that *H. postflava* typically completes two or three generations per year.

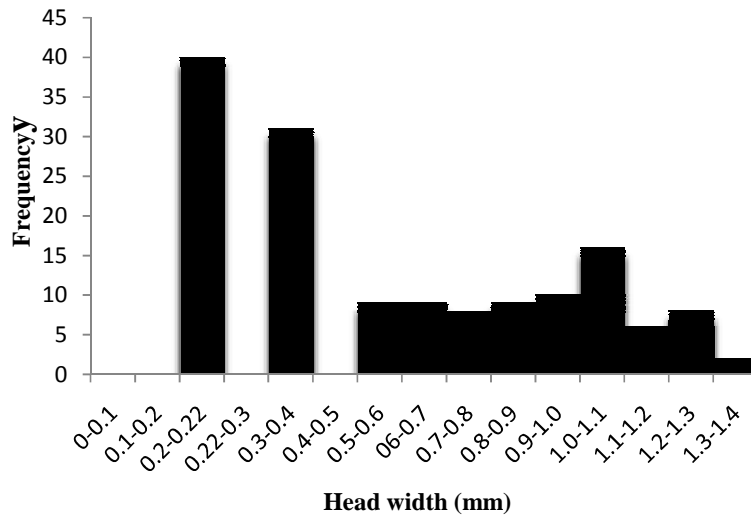


Fig. 2. Frequency of head width of moth larvae reared under the laboratorial condition.

Table 1. Life cycle and life time (days, average \pm SD (n)) of both female adult and male adult of *H. postflava*.

Immature stage			Mature stage			
Egg	Larva	Pupa	Before laying	Life cycle	Life time of female	Life time of male
3-8 5.72 ± 1.23 (n=110) 28.8°C; 85.4% RH	20-25 22.03 ± 1.75 (n=60) 31.8°C; 85.1% RH	7-10 8.33 ± 0.99 (n=40) 35.3°C; 83.7% RH	3-6 4.38 ± 1.02 (n=30) 36.5°C; 82.3% RH	33-49 40.46 ± 4.96 (n=30) 33.3°C; 83.1% RH	6-9 7.76 ± 1.04 (n=31) 35.2°C; 83.5% RH	6-9 7.51 ± 1.03 (n=39) 35.2°C; 83.5% RH

Table 2. Survivorship ratio of larva and pupa and sex ratio of *H. postflava*.

Larva			Pupa			Adult		
Number observed	Number emerged	Ratio (%)	Number observed	Number emerged	Ratio (%)	Female	Male	Ratio
50	44	88	40	33	82.50	31	39	1: 1.26
33.8°C; 84.3% RH			35.2°C; 84.1% RH					

Survivorship ratio of larva and pupa of *H. postflava* was 88% and 82.5% respectively (Table 2). In all study time, most of moth larvae reared with individuals of 1st and 2nd age died after 2-3 days. This can be explained the following: Either the habit of colony life, it means here they help each other in foraging for the food or mechanical impacts in experimental manipulations. A total of 70 adult moths examined in the laboratory. Of these, 31 were females, and 39 were males (Table 2). Hence the sex ratio here (:) was 1:1.26. In comparison with that above, it is inconsiderably different. With the difference about the ratio between the two genders, it can also suggest that there is choice of females to

males when they mate together. This is one of the causes which lead unsuccessful mating of moth pairs experimented (showed below).

In a total of 18 experimented pairs, 3 pairs did not lay eggs (3, 6, and 9), 15 pairs dissected still remained eggs in the body (Table 3). The following causes are to be considered: 1) unmated females; 2) rearing space; 3) food to rear immature and adult stage (larvae of *C. cephalonica* and the honey); 4) temperature and humidity in the laboratory; or 5) unmatured eggs. As for 3 pairs (3, 6 and 9), causes of 2, 3, and 4 are rejected due to the other pairs (laying eggs). All of such five causes are referred to the case of 15 pairs.

Table 3. Data on eggs of *H. postflava*.

Pairs	Eggs laid	Eggs remained in the body	A total of eggs	Eggs hatched	Rate of hatched eggs (%)	Situation of eggs
1	34	50	84	0	0	C
2	64	20	84	6	9.4	C
3	0	83	83	0	-	-
4	20	62	82	3	15	S
5	80	11	91	66	82.5	C,S
6	0	88	88	0	-	-
7	84	32	116	0	0	C
8	73	19	92	0	0	C,S
9	0	88	88	0	-	-
10	10	78	88	0	0	S
11	71	10	81	0	0	C,S
12	55	26	81	42	76.4	C,S
13	87	11	98	7	8.0	C
14	25	-	-	0	0	S
15	15	74	89	0	0	C
16	61	-	-	57	93.4	C,S
17	15	-	-	0	0	S
18	15	74	89	0	0	S
Mean	39.39	48.40	88.93	10.06	18.98	

C. Clump, S. Single

Hence, the mean egg total laid was only 39.39 eggs/pair. The egg total of a female moth ranged from 81 to 116 (mean 88.93 eggs). Also this snout moth, with the food of pupae of the paper wasp *P. jokahamae*, a female moth lays a mean of 133.9 eggs during their mean lifetime of 10.7 days (Kato *et al.*, 2007a). Thus, the fecundity of *H. postflava* is much dependent on the food and local climate. Rate of hatched eggs was very low, ranging from 0 to 93.4% (an average of 18.98%/pair). This is also considered as such four causes of 1, 3, 4, and 5 above. As for situation of eggs, female adults of the moth laid eggs singly or in clumps of a few eggs. This datum is the same as that reported by Kato *et al.*, (2007a).

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