Studies on the dung-breeding flies in Japan

IV. The immature stages of three muscine species occurring from wild brown bear dung (Diptera: Muscidae, Muscinae)

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Abstract: The immature stages of three muscine species, *Pyrellia tateyamensis* Shinonaga, *Mesembrina resplendens* Wahlberg and *Huckettomyia watanabei* Pont et Shinonaga, occurring from wild brown bear dung were newly described and their characteristics of taxonomic and biological significance were discussed. The third instar larva of *P. tateyamensis* was of typical Muscini-type, and can be distinguished from those of the known *Dasyphora*-larva in having a pair of extra-anal papillae. This larva also differs from that of *P. cadaverina* (Linnaeus) in the characteristics of posterior spiracles. The larval mode of life of *M. resplendens* was trimorphic obligatory coprophagous. The third instar larva of *resplendens* is partially related to those of Hydrataeini and Phaoniinae-Mydaeinae, and can be distinguished from that of a Palaearctic species, *M. meridiana* Linnaeus in having doubled number of branches on anterior spiracles and by the characteristics of posterior spiracles, but extremely resemble that of *M. mystacea* Linnaeus described from Russia. Egg of *H. watanabei* was of typical muscine-type, but the larval characteristics have a close relationship to those of Phaoniinae and Mydaeinae. The third instar larva of this species seems to be facultative carnivorous.

INTRODUCTION

Nishijima and Iwasa (1979, 1984) reported

on the flies occurring from dung of wild brown bear, *Ursus arctos* Lydekker, in Hokkaido, Japan. These flies exclusively occur in mountainous areas, and their immature stages have not been known until now. Recently we got the immature stages of three muscine-species, namely *P. tateyamensis*, *M. resplendens*, and *H. watanabei*, occurring from brown bear dung. In the present paper, we report on their immature stages and discuss on some characteristics of taxonomic and biological significance.

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Figs. 1-5 Third instar larva of *Pyrellia tateyamensis* 1: lateral view, 2: anal plate, ventral view, 3: posterior spiracles, posterior view, 4: cephalopharyngeal sclerite, lateral view, 5: ditto, dorsal view in unfolded condition.

Scale: 0.5 mm.

MATERIALS AND METHODS

The adult females of *P. tateyamensis* and *M. resplendens* were collected at Kamisatsunai of the foot of Hidaka mountain ranges. While those of *H. watanabei* were collected at Mt. Koikakushu-satsunai of the same mountain ranges. The immature stages were obtained and observed by the methods described by Iwasa (1983).

***Pyrellia tateyamensis* Shinonaga, 1976**

(Figs. 1-5)

Pyrellia tateyamensis Shinonaga, *Jap. J. Sanit. Zool.*, 27: 423.

Third instar larva. Fully mature larva about 10 mm in length; yellow color; anterior margins of 6th to 11th segments with microscopic ventral papillae (Fig. 1); anal plate slightly protuberant and pigmented with brown; subanal papillae developed; postanal papillae also developed and with microscopic spines; extra-anal papillae present (Fig. 2); anterior spiracle with 8 to 9 branches; spiracular stalks of posterior spiracles not projected; posterior spiracular plate black except slits; slits yellow and distinctly sinuated (Fig. 3); button only a very small yellow spot; mouth hooks of cephalopharyngeal sclerite asymmetrical, pointed in left side and rounded in right side apically; accessory sclerites consist of only oral bars; dental sclerites completely separated ventrally (Fig. 5); pharyngeal sclerite comparatively massive in lateral view; rounded process present under the anterodorsal bridge; ventral cornua slightly longer than dorsal cornua; incision about half length of pharyngeal sclerite; pharyngeal floor transparent and with 7 ventral pharyngeal ridges which are completely developed towards posterior part (Fig. 5).

***Mesembrina resplendens* Wahlberg, 1844**

(Figs. 6-17)

Mesembrina resplendens Wahlberg, *Oefvers. K. Vet. Akad. Forhandl.*, 1: 66.

Egg. Large size, about 3.5 mm in length and 0.8 mm in width; white color and typical muscine-type; chorion surface with a reticu-

lation of hexagonal meshes; hatching strip of concave surface without hexagonal meshes (Fig. 6).

First instar larva. About 3 to 4 mm in length; white color; anterior margins of 5 or 6th segments to 11th segments each with black ventral spinose band (Fig. 7); anterior spiracles not distinct, but slightly visible; posterior spiracles very small and heart-shaped (Fig. 9); cephalopharyngeal sclerite undeveloped and weakly sclerotized (Fig. 8).

Second instar larva. About 6 mm in length; white color; anterior margins of 6th to 12th segments each with ventral spinose band; anterior spiracles distinct; posterior spiracles with 2 slits (Fig. 11); mouth hooks, accessory sclerites and dental sclerites of cephalopharyngeal sclerite distinctly developed; pharyngeal sclerite weakly pigmented, and both cornuae undeveloped (Fig. 10).

Third instar larva. Large size, fully mature larva about 14 to 15 mm in length; yellow color; anterior margins of 7th to 12th segments with microscopic ventral papillae (Fig. 14); anal plate slightly protuberant, subanal papillae developed; postanal papillae also developed and with many microscopic spines; extra-anal papillae present (Fig. 15); anterior spiracle with 9 branches; spiracular stalks of posterior spiracles slightly projected and black; posterior spiracular plates brownish, darkened marginally; slits gently sinuated (Fig. 16); button small; mouth hooks of cephalopharyngeal sclerite slightly asymmetrical, sharply pointed in left and slightly rounded in right apically (Fig. 13); accessory sclerites consist of anterior ribbons and oral bars; dental sclerites not joined by a median ventral arch, but closely apposed ventrally; hypostomal sclerites not slender; pharyngeal sclerite comparatively thick in lateral view; rounded process present under the anterodorsal bridge; ventral cornua slightly longer than dorsal cornua; incision deep, beyond the half length of pharyngeal sclerite (Fig. 12); pharyngeal floor transparent, and with 7 ventral pharyngeal ridges (Fig. 13).

Puparium. Barrel-shaped, broadest at the center and thin in 1st and 2nd segments; about 9 mm in length; reddish brown color; posterior spiracular plates black; respiratory horns black and small (Fig. 17).

Figs. 6-13 *Mesembrina resplendens* 6: egg, 7: first instar larva, lateral view, 8: cephalopharyngeal sclerite of first instar larva, lateral view, 9: posterior spiracles of first instar larva, posterior view, 10: cephalopharyngeal sclerite of second instar larva, lateral view, 11: posterior spiracles of second instar larva, posterior view, 12: cephalopharyngeal sclerite of third instar larva, lateral view, 13: ditto, dorsal view in unfolded condition.
Scale: 0.5 mm.

Figs. 14–17 *Mesembrina resplendens* 14: third instar larva, lateral view, 15: 12th segment of third instar larva, ventral view, 16: posterior spiracles of third instar larva, posterior view, 17: puparium, dorsal view.
Scale: 1 mm (except Fig. 16 which is 0.25 mm).

***Huckettomyia watanabei* Pont et
Shinonaga, 1970**
(Figs. 18–26)

Huckettomyia watanabei Pont et Shinonaga,
Jap. J. Sanit. Zool., 21: 193.

Egg. About 2 mm in length, 0.7 mm in width; white color; muscine-type; chorion surface with a reticulation of hexagonal meshes except hatching strip (Fig. 18).

First instar larva. Only exuvium was obtained by dissection of unhatched egg. Anterior margins of 5th to 12th segments ventrally with black spinose bands; cephalopharyngeal sclerite vestigial (Fig. 20).

Second instar larva. Material was also obtained by dissection of an unhatched egg. About 1.7 mm in length; white color; cephalopharyngeal sclerite undeveloped and

weakly pigmented (Fig. 21); posterior spiracles very small and heart-shaped.

Third instar larva. Medium size, fully mature larva about 10 mm in length; yellow color; 6th to 12th segments each with microscopic ventral papillae (Fig. 22); 12th segments slender posteriorly; anal plate slightly protuberant; anal papillae undeveloped; subanal and postanal papillae developed; extra-anal papillae developed into 2 pairs (Fig. 23); anterior spiracle with 5 to 6 branches; posterior spiracular plates brownish; slits gently sinuated (Fig. 24); button comparatively large; mouth hooks of cephalopharyngeal sclerite slightly asymmetrical (Fig. 26); accessory sclerites consist of anterior ribbons, oral bars and posterior ribbons; dental sclerites closely apposed ventrally (Fig. 26); hypostomal sclerite not slender; pharyngeal sclerite slender in lateral

view; incision deep, beyond the half length of pharyngeal sclerite (Fig. 25); ventral cornua longer than dorsal cornua; pharyngeal floor transparent and with 7 ventral pharyngeal ridges (Fig. 26).

DISCUSSION

The larvae of the genus *Pyrellia* have been described in only 2 species, *P. cadaverina* Linnaeus by Portchinsky (1910) and Zimin (1948), and *P. tasmaniae* Macquart by Ferrar (1979). The larvae of *cadaverina* are known to breed in horse dung, while those of *tasmaniae* were reared from wambat dung in Australia (Ferrar, 1979). The larvae of *tateyamensis* are considered to mainly breed in brown bear dung and the food habit is obligatory coprophagous as well as those of *cadaverina* and *tasmaniae*.

The genus *Pyrellia* is placed in the tribe Muscini of Muscinae and closely related to the genera *Dasyphora* and *Orthellia*. But there are some taxonomic problems among these genera. Skidmore (1973b) paid attention to the oral bars of cephalopharyngeal sclerite in his work of muscid larvae, and suggested that 2 *Dasyphora*-species, *cyanicolor* (Zetterstedt) and *cyanella* Meigen whose larvae have the oral bars should be transferred to the *Pyrellia* whose larvae have the oral bars, restricting *Dasyphora* to those species which lack the oral bars as in *Musca*. The larva of *tateyamensis* also have the oral bars. But Ferrar (1979) noted that the larva of *tasmaniae* lack the oral bars. In the Japanese *Orthellia*-larvae, Shinonaga and Kano (1973) recognized the oral bars in 4

species, but didn't in 1 species. The oral bars are variably distributed and seem to be of less taxonomic value among the three genera, *Pyrellia*, *Dasyphora* and *Orthellia*. Moreover, Skidmore (1973b) separated the *Orthellia*-larvae from *Pyrellia*-larvae by lacking the rounded process on pharyngeal sclerite in his key. But Ferrar (1979) doubted the taxonomic value of this process. In fact, Shinonaga and Kano (1973) found the rounded process in all Japanese *Orthellia*-larvae. It seems that there is no discriminative characteristics between *Pyrellia*- and *Orthellia*-larvae. The known third instar larvae of *Pyrellia* including *tateyamensis* differ from those of the known three *Dasyphora*-larvae, *cyanicolor*, *cyanella* and *asiatica* by having a pair of extra-anal papillae. The third instar of *tateyamensis* also can be distinguished from that of *cadaverina* by the characteristics of posterior spiracles. The larvae of *Pyrellia* are of typical Muscini-type in the following characteristics: completely separated dental sclerites, distinctly asymmetrical mouth hooks, accessory sclerites consist of only oral bars, massive pharyngeal sclerite, shallow incision, a considerable number of branches of anterior spiracles, radically sinuated slits of posterior spiracles.

The larvae of the genus *Mesembrina* have been reported in 2 species, *M. meridiana* and *M. mystacea*. The former has been described by Portchinsky (1910), Keilin and Tate (1930) and Thomson (1937), and the latter has been described by Portchinsky (1910, 1911) and Keilin and Tate (1930). Portchinsky (1910) and Ségué (1923) regarded the larvae of *meridiana* as being

Figs. 18–26 *Huckettomyia watanabei* 18: egg, 19: larva obtained by dissection of egg, lateral view, 20: cephalopharyngeal sclerite of first instar larva, lateral view, 21: cephalopharyngeal sclerite of second instar larva, lateral view, 22: third instar larva, lateral view, 23: anal plate of third instar larva, ventral view, 24: posterior spiracles of third instar larva, posterior view, 25: cephalopharyngeal sclerite of third instar larva, lateral view, 26: ditto, dorsal view in unfolded condition.
Scale: 0.5 mm.

ABBREVIATIONS USED IN FIGURES

ADB, anterodorsal bridge; AP, anal plate; AR, anterior ribbon; AS, anterior spiracle; B, button; DC, dorsal cornua; DS, dental sclerite; EAP, extra-anal papilla; HS, hypostomal sclerite; I, incision; MF, mouth hook; OB, oral bar; PAP, postanal papilla; PR, posterior ribbon; PRH, pupal respiratory horn; RP, rounded process; S, slit; SAP, subanal papilla; VC, ventral cornua; VMP, ventral microscopic papilla; VPR, ventral pharyngeal ridge.

obligatory coprophagous, but Thomson (1937) suggested that their mode of larval life was facultative carnivorous. The larvae of *mystacea* were also suspected to have both modes of life of coprophagous and carnivorous by Portchinsky (1910) and Keilin and Tate (1930). In the present observation three instars of *resplendens* all were obligatory coprophagous.

Dental sclerites of third instar of *resplendens* are not joined by a median ventral arch, but they are closely apposed ventrally. According to Keilin and Tate (1930) and Thomson (1937), dental sclerites of *meridiana* are joined by a strong median ventral arch. On the other hand, those of *mystacea* are joined by a small median ventral arch (Keilin and Tate, 1930). Dental sclerites of the larvae of Muscini such as *Musca*, *Orthellia* and *Pyrellia* are known to be completely separated ventrally. While those of larvae belonging to the Phaoniinae and Mydaeinae are generally joined by a strong median ventral arch. The structure of dental sclerites of *Mesembrina*-larvae, though that of *resplendens* seems to be slightly different from those of *meridiana* and *mystacea*, shows an intermediate form between Muscini and Phaoniinae-Mydaeinae.

The third instar larva of *resplendens* can be distinguished from that of *meridiana* by having twice number of branches on anterior spiracles and by the characteristics of posterior spiracles, but extremely resemble that of *mystacea*.

Huckettomyia watanabei was placed in the tribe Hydrotaeini of Muscinae as a monotypy by Pont and Shinonaga (1970). Egg of this species is of typical muscine-type, showing reasonable taxonomic situation of this species. A larva obtained by dissection of an unhatched egg is shown in Fig. 19. This larva seems to be 2nd instar larva sheathed by a exuvium of 1st instar. Cephalopharyngeal sclerite of 1st instar left in a exuvium is undeveloped and vestigial (Fig. 20). The 2nd instar may be coprophagous, but the third instar is considered to be facultative carnivorous. Skidmore (1973a) divided the larval life of Muscidae into 4 types, viz. trimorphic saprophagous, trimorphic facultative carnivorous, dimorphic obligatory carnivorous and monomorphic obligatory

carnivorous, and included some genera, e.g. *Synthesiomyia*, *Azelia*, *Dendrophaonia* and *Ophyra* of Hydrotaeini in trimorphic facultative carnivorous type. The larval life of *Huckettomyia* may be also included in this type. However, if eclosion and ecdysis coincide with each other, it is a dimorphic facultative carnivorous type. Conclusion cannot be drawn in the present observation. The third instar larva of *Huckettomyia* is close to those of Phaoniinae and Mydaeinae in the following respects: ventrally apposed dental sclerites, indistinctly asymmetrical mouth hooks, accessory sclerites consist of 3 pairs of sclerites, slender pharyngeal sclerite, deep incision, less number of branches of anterior spiracles, gently sinuated slits of posterior spiracles.

In Muscinae, the larvae of Muscini such as *Musca*, *Orthellia*, *Dasyphora* including *Pyrellia* are of typical Muscini-type and believed to be almost saprophagous. On the other hand, some larvae of Hydrotaeini such as *Hydrotaea* and *Ophyra* including *Huckettomyia* are similar to those of Phaoniinae and Mydaeinae, and considered to be facultative or obligatory carnivorous. Hennig (1956) mentioned that the larvae of *Mesembrina* and *Polietes* have the ventrally fused dental sclerites and the developed accessory sclerites like as those of Phaoniinae. Some larvae of *Polietes* have been observed to be carnivorous by many authors. But Iwasa (1980) reported that the larva of *P. nigrolimbatus* Bonsdorff has the ventrally separated dental sclerites and its food habits is coprophagous. As mentioned above, the food habits of *M. meridiana* and *M. mystacea* were suspected to be carnivorous by some authors. *Mesembrina* and *Polietes* are placed in Muscini, but their larvae may have some variety in both food habits and morphological characteristics and represent a transitional form between the typical Muscini and the Hydrotaeini, Phaoniinae-Mydaeinae.

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摘 要

糞より発生するハエ類の研究

Ⅳ. クマの糞より発生するイエバエ亜科 (Muscinae) の3種の若齢期について (双翅目, イエバエ科)

西島・岩佐 (1979, 1984) は、ヒグマの糞より発生するハエ類について報告した。これらのハエは山地のみに生息することから、それらの若齢期についてはほとんど知られていない。著者らは、これらのうちイエバエ亜科に属する3種、タテヤマコミドリイエバエ *Pyrellia tateyamensis* Shinonaga, キバネクロバエ *Mesembrina resplendens* Wahlberg, ワタナベトゲアシイエバエ *Huckettomyia watanabei* Pont et Shinonaga の若齢期を新しく記載し、分類学上および食性上重要な形質について論じた。タテヤマコミドリイエバエの3齢幼虫は糞食性で、近縁の *Dasyphora* 属とは extra-anal papillae をもつことにより区別でき、同属のコミドリイエバエ *P. cadaverina* とは後方気門の特徴により区別できる。キバネクロバエは、1齢、2齢、3齢、とも糞食性で、3齢幼虫は旧北区に生息する *Mesembrina meridiana* とは前方気門の数と後方気門の特徴により区別できるが、ソ連から記載されている *M. mystacea* に酷似している。ワタナベトゲアシイエバエの卵は、典型的なイエバエ亜科型であるが、3齢幼虫はトゲアシイエバエ亜科やマルハナイエバエ亜科の幼虫と共通の特徴をもっていた。この種の2齢は、糞食性と思われるが、3齢は facultative carnivorous と考えられる。

3齢幼虫のとくに口鉤の対称性、付属片や歯板の構造、咽頭板の形態・構造、前・後方気門などの特徴において、タテヤマコミドリイエバエは典型的なイエバエ亜科型で、ワタナベトゲアシイエバエはトゲアシイエバエやマルハナイエバエに近く、キバネクロバエは両者の中間移行型の特徴を示した。*Mesembrina* 属の他種の幼虫の食性については、同じ Muscini に属するクロハナイエバエ属 (Genus *Polietes*) の幼虫と同様に不明な点が多い。