

## IMMATURE STAGES AND DEVELOPMENTAL BIOLOGY OF TWO MUSCID FLIES (*Cyclorrhapha*: Diptera) WHICH BREED IN CARRION IN SOUTHERN NIGERIA

**EKANEM, M. S.**

Department of Zoology, University of Uyo, Uyo

### Abstract

Two muscid flies of forensic importance, *Morellia nilotica* (Leow) and *Alluaudinella flavicornis* (Macquart) breed in carrion in Southern Nigeria. *M. nilotica* and *A. flavicornis* were bred in rotting beef meat. Morphological descriptions and developmental rates of the eggs, larval instars, and pupae are given. Average developmental rate of *M. nilotica* from egg to adult is 14.7 days, and *A. flavicornis*, 18.4 days. Keys to eggs, larval instars and pupae are given.

**Keywords:** Eggs, larval instars, pupae, developmental rates

---

### Introduction

The primary consumers of carrion are usually dipterous insects, particularly the calliphorids, (Debang and Greenberg, 1989; Ekanem and Usua, 2005). Calliphorid larvae feed and break open the carcass and expose it to other insects and arthropods which either come to breed and feed on the carcass or prey on other participants of the food resource. This important ecological role leading to the total decomposition of the carcass is also of importance to the forensic entomologist as a means of calculating the post mortem interval in homicide cases. Although records of arthropod successions on carrion in the tropics are few, actual progress in these few recorded studies will be made when the arthropods decomposers, particularly their immature stages can be recognized. Among the secondary invaders of carrion in southern Nigeria are muscids. Two of them, *Morellia nilotica* (Leow) and *Alluaudinella flavicornis* (Macquart) are known to breed in animal carrions in southern Nigeria. This study was undertaken to describe the eggs, larval instars, the puparia and developmental rates of these two flies.

### Materials and Methods

Third instars of *Morellia nilotica* were collected from a decaying pig carcass in Uyo, an urban town in south eastern Nigeria and reared on beef meat. The larvae were reared in netted cages (Ekanem and Usua, 2000). Rearing procedure was according to Greenberg and George (1985). Three egg batches (first generation) were obtained from the wild population and reared through two more generations to obtain 29 replicates.

Eggs of *Alluaudinella flavicornis* were collected from decaying carcasses of the giant African snail, *Achatatina* sp. Three generations of this fly were also reared on beef meat as with *M. nilotica* to obtain 31 replicates.

Samples of the eggs, each instar, and the pupae were preserved in 70% ethanol/glycerin solution, and 80% ethanol/glycerin/glacial acetic acid solution, (8:1:1) (Greenberg and Szyska 1984). Also, for detailed studies of the cephalopharyngeal skeletons, spine bands, anterior and posterior spiracles, and tubercle arrangement, the three instars were cleared in boiling 10% KOH and preserved according to Greenberg and Szyska (1984).

The anterior and posterior spiracles of only the third instars were

described here because anterior spiracles only appear from the second instar, and the pattern is typical; the posterior spiracle is also typical having one slit in first instar, two in second instar and three in third instar.

## Results and Discussion

### Diagnostic Descriptions of Preadult Stages Muscinae:

#### *Morellia nilotica* (Loew)

**Egg:** Creamy white in colour; length  $0.55 \pm 0.05$  mm (n = 12) (Fig.1a)

**First instar:** Spine pattern similar to third instar (Fig.1d) Cephalopharyngeal skeleton as in (Fig.1b)

**Second instar:** Spine pattern similar to third instar (Fig.1d) Cephalopharyngeal skeleton as in (Fig.1c) anterior spiracles have 5 – 6 branches (n = 8).

**Third instar:** Anterior of segments 2 – 12 each encircled with a single row of spines (Fig.1d); segment 12 with posterior spiracles protruding; segments devoid of fusiform areas. Cephalopharyngeal skeleton as in (Fig.1e.) Anterior spiracle (Fig.1f) with 5 – 7 branches (n = 10). Posterior spiracular field with no tubercles but ridged areas (Fig.1g). Posterior spiracle surrounded by conspicuously sclerotized and complete peritremes without buttons (Fig.1h); mean spiracular separation  $0.14 \pm 0.01$  mm (n = 10); mean spiracular width  $0.3 \pm 0.09$  mm (n = 20).

**Puparium:** Cuticular features as in third instars except for a pair of horns posteriorly on segment four (Fig.1j); mean length of puparium  $6.0 \pm 1.1$  mm (n = 15).

Egg batches contain 30 – 60 eggs (n = 8, batches). Hatching occurs in  $15.05 \pm 0.003$  hours (n = 17). The first instars on hatching measured about 1 mm in length. Duration of stage was  $22.0 \pm 0.21$  hours (n = 17). When about 3mm in length, larva moults into second instar. Duration of second instar is  $22.3 \pm 0.13$  hours (n = 21). When almost 8.00 mm in length, larva moults into third instar. In  $62.4 \pm 0.01$  hours ( $2.6 \pm 0.04$  days) (n = 26), and larva over 10 mm in length, it enters the

prepupal stage which lasts for  $43.2 \pm 0.01$  hours ( $1.8 \pm 0.05$  days) (n = 24). Prepupae leave the breeding medium to pupate under the sand. The following pupal period lasts  $7.8 \pm 0.3$  days (n = 27).

Adult *M. nilotica* were recorded as from the bloated stage of the pig carcass. The fly arrived to oviposit at this time and continued till the opening out of the carcasses (decay stage). As the carcass started to dry up, adult numbers dropped drastically.

#### Phaoniinae:

#### *Alluaudinella flavicornis* (Macquart)

**Egg:** Creamy white in colour, partly enclosed in a white wing-like device (Fig. 2a); length  $2.1 \pm 0.1$  mm

**First instar:** Spine pattern as in third instar (Fig.2d). Cephalopharyngeal skeleton as in Fig. 2b; dorsal arch of skeleton weakly developed and porous.

**Second instar:** Spine pattern as in third instar (Fig.2d), Cephalopharyngeal skeleton as in Fig. 2c; dorsal arch of skeleton still porous. Anterior spiracles with 9 – 10 branches (n = 12).

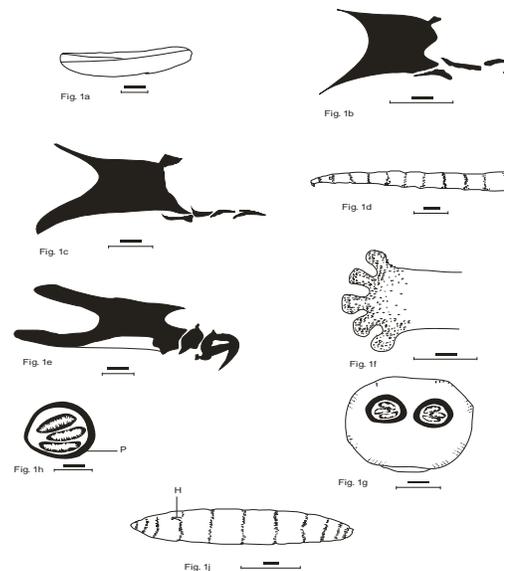


Fig. 1a - j: *Morellia nilotica*. Egg (a), Cephalopharyngeal skeleton, 1st instar (b), 2nd instar (c) 3rd instar (e). Larva, 3rd instar (d). Anterior spiracle, 3rd instar (f). Posterior spiracular field (g). Posterior spiracle (h) Puparium (j) Peritreme (P) Horn (H)

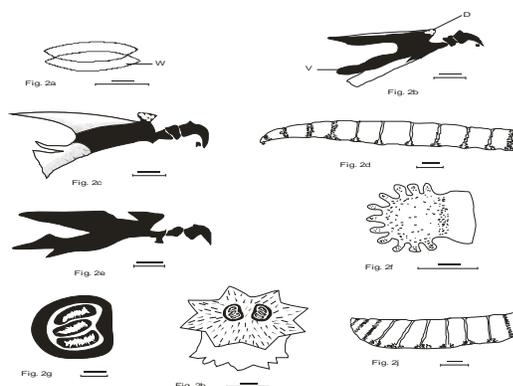


Fig. 2a -j: *Alluaudinella flavicornis*. Egg (a). Cephalopharyngeal skeleton, 1st instar (b). 2nd instar (c) 3rd instar (d). Larva, 3rd instar (e). Anterior spiracle, 3rd instar (f). Posterior spiracular field (g). Posterior spiracle (h) Puparium (i) Wing (j). Dorsal arch (D) Ventral cornu (V)

**Third instar:** Spine pattern as in Fig. 2d; segment 12 with several rows of latero-ventral spines; posterior spiracular field with pigmented and single-pointed spines. Cephalo-pharyngeal skeleton completely sclerotized (Fig. 2e). Anterior spiracles with 10 – 11 branches (n = 12), (Fig. 2f). Posterior spiracular field bears protruding and heavily sclerotized spiracles with complete peritremes without buttons (Fig.2g). Mean spiracular separation  $0.16 \pm 0.01$  mm (n = 12), and mean spiracular width  $0.50 \pm 0.05$  mm (n = 24) (Fig.2h). Distance between tubercles approximately equal ( $0.60 \pm 0.01$  mm), n = 12).

**Puparium:** Cuticular features as in third instar (Fig.2j). Mean length of puparium  $10.6 \pm 0.2$  mm (n = 12)

A batch of eggs contain 14 – 40 eggs which are laid singly. Mean incubation period of the egg is  $27.5 \pm 1.0$  hours (n = 29 batches). The first instar on hatching measures about 2 mm in length, and its mean duration is  $18.7 \pm 1.3$  hours (n = 22). At the end of period, larva measures about 4mm in length and moults into second instar. Mean duration of second instar is  $18.3 \pm 1.4$  hours (n = 25) and larva measures about 8mm in length. Mean duration of third instar is  $2.0 \pm 0.4$  days (n = 27). At almost 16mm in length the prepupa leaves the wet part of the breeding medium, and its duration is  $1.2 \pm 0.3$  days (n = 27). At end of the period it pupates and the pupal period is  $12.5 \pm 2.4$  days (n = 27).

Eggs of *A. flavicornis* were collected from carcasses of the giant African snail (*Achachatina sp.*) inside a room. Presence of these eggs on a carcass inside a room suggests this fly may as well be endophilic.

**Bionomics:** Developmental rates of the two muscids are given in Table 1

**Table 1: Developmental rates of *M. nilotica* and *A. flavicornis***

	Average duration h (hours)							Egg to adult (days)
	Egg	Larva I	Larva II	Larva III	Prepupa	Larval duration	Pupa (days)	
Muscinae								
<i>M. nilotica</i>	15.05	22.0	22.3	62.4	43.2	165.0	7.8	14.7
Phaoniinae								
<i>A. flavicornis</i>	27.5	18.7	18.3	48.0	28.8	141.3	12.5	18.4

**Data are means of replicate rearings; temperature inside cages ranged between 26-31°C and relative humidity from 57 – 89%**

**Key to Eggs**

- |    |   |                       |
|----|---|-----------------------|
| 1. | Length > 2.1 mm                         | 2                     |
|    | Length 0.6 – 0.8 mm                     | 2                     |
| 2. | Egg partly enclosed by wing like device | <i>A. flavicornis</i> |
|    | Egg without a wing like device          | <i>M. nilotica</i>    |

**Key to Larval instars**

- |    |   |               |
|----|---|---------------|
| 1. | Anterior spiracles absent                 | First instar  |
|    | Anterior spiracles                        | 2             |
| 2. | Posterior spiracles with indistinct slits | First instar  |
|    | Posterior spiracles with distinct slits   | 3             |
| 3. | Posterior spiracles with two slits        | Second instar |
|    | Posterior spiracles with three slits      | Third instar  |

**Key to First Instar Larvae**

- |    |   |                       |
|----|---|-----------------------|
| 1. | Larva measuring 1.0 – 3 mm in length  | 2                     |
|    | Larva measuring 2.0 – 4.0 mm in length  | 2                     |
| 2. | Anterior of segments 2 – 12 completely encircled with single row of spine bands         | 3                     |
|    | Anterior of segments 2 – 5 and 12 completely encircled with several rows of spine bands | 3                     |
| 3. | Segment 12 without dorso ventral spines   | <i>M. nilotica</i>    |
|    | Segment 12 with dorso ventral spines  | <i>A. flavicornis</i> |
| 4. | Dorsal arch of tentorial phragma rounded and porous                                     | 5                     |
|    | Dorsal arch of tentorial phragma not porous   | 5                     |
| 5. | Dorsal and ventral cornu of cephalopharyngeal skeleton with rounded posterior tips      | <i>A. flavicornis</i> |
|    | Dorsal arch of tentorial phragma not porous, and skeleton with pointed posterior tip    | <i>M. nilotica</i>    |
| 6. | Posterior spiracular field tuberculate  | <i>A. flavicornis</i> |
|    | Posterior spiracular field not tuberculate  | <i>M. nilotica</i>    |

**Key to Second Instar Larvae**

- |    |  |                       |
|----|--|-----------------------|
| 1. | Larva measuring 3 – 8 mm in length   | 2                     |
|    | Larva measuring 4.00 – 8.00 mm in length                                     | 2                     |
| 2. | Anterior of segments 2 – 12 encircled with single rows of spine bands        | 3                     |
|    | Anterior of segments 2 – 5 and 12 encircled with several rows of spine bands | 3                     |
| 3. | Segment 12 without dorsoventral spines                                       | <i>M. nilotica</i>    |
|    | Segment 12 with dorsoventral spines  | <i>A. flavicornis</i> |

- |    |   |                       |
|----|---|-----------------------|
| 4. | Dorsal arch of tentorial phragma present and porous | <i>A. flavicornis</i> |
|    | Dorsal arch of tentorial phragma not porous         | <i>M. nilotica</i>    |
| 5. | Anterior spiracles with < 6 branches                | <i>M. nilotica</i>    |
|    | Anterior spiracles with >9 branches                 | <i>A. flavicornis</i> |
| 6. | Posterior spiracular field tuberculate              | <i>A. flavicornis</i> |
|    | Posterior spiracular field not tuberculate          | <i>M. nilotica</i>    |

**Key to Third Instar Larvae**

- |    |  |                       |
|----|--|-----------------------|
| 1. | Larva measuring 8.00 – 10.9 mm   | 2                     |
|    | Larva measuring 8.00 – 16.00 mm in length                                    | 2                     |
| 2. | Anterior of segments 2 – 12 encircled with single rows of spine bands        | 3                     |
|    | Anterior of segments 2 – 5 and 12 encircled with several rows of spine bands | 3                     |
| 3. | Segments 12 without dorsoventral spines                                      | <i>M. nilotica</i>    |
|    | segments 12 with dorsoventral spines   | <i>A. flavicornis</i> |
| 4. | Anterior spiracles with < 7 branches   | <i>M. nilotica</i>    |
|    | Anterior spiracles with > 10 branches  | <i>A. flavicornis</i> |
| 5. | Posterior spiracular field tuberculate                                       | <i>A. flavicornis</i> |
|    | Posterior spiracular field not tuberculate                                   | <i>M. nilotica</i>    |
| 6. | Peritremes bean – shaped   | <i>A. flavicornis</i> |
|    | Peritremes oval in shape   | <i>M. nilotica</i>    |

**Key to Puparia**

- |    |  |                       |
|----|--|-----------------------|
| 1. | Puparium 6.00 – 6.20 mm long                           | 2                     |
|    | Puparium 10.00 – 10.50 mm long                         | 2                     |
| 2. | Puparium with a pair of horns posteriorly on segment 4 | <i>M. nilotica</i>    |
|    | Puparium without any horns                             | <i>A. flavicornis</i> |

**Acknowledgements**

I wish to thank the following for their invaluable contributions to this study. Professor Efanga, J. Usua of the University of Calabar, and Mike C. Dike of the Ahmadu Bello University, Zaria, as well as the students and staff of the Department of Zoology, University of Uyo, Nigeria.

**References**

- Debang, L. and B. Greenberg (1989). Immature stages of some flies of forensic importance. *Annals of the Entomol. Soc. of America*. 82 (1) 80 – 93.
- Ekanem, M.S. and E.J. Usua (2000). Immature stages and Biology of two blowfly species (Diptera: Calliphoridae) in Akwa Ibom State of Nigeria. *Nigerian Journal of Entomology*. 17:1-11.

Ekanem, M.S.

Ekanem, M.S. and E.J. Usua (2005). Preliminary study of arthropod species Development and succession on carrion in Akwa Ibom State, Nigeria. *Nigerian Journal of Entomology*: 22, 18-31.

Greenberg B and M. L. Szyska (1984). Immature stages and Biology of Fifteen species of Peruvian Calliphoridae (Diptera). *Annals of the Entomol. Soc. of America*. 77 (5) 488 – 517.

Greenberg B. and J. George (1985). *Handbook of insect rearing, Vol. 2*, Pritain Singh & R. F. Moore (Eds) Elsevier Science Publishers B. V. Amsterdam pp. 25-33, 93-96.