

Immature Stages and Biology of two Blowfly Species (Diptera: Calliphoridae) in Akwa Ibom State, Nigeria.

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ABSTRACT

Chrysomya chloropyga (Wiedemann) and *Hemipyrellia fernandica* (Macquart) are two common calliphorids in Akwa Ibom State, Nigeria. Morphological descriptions are given of first, second, third instars, and puparia. Larval instars of *C. chloropyga* have segments with fusiform areas, and the posterior spiracle peritreme is incomplete and highly sclerotized. The peritreme in *H. fernandica* is complete and encloses a button. Developmental rates of *C. chloropyga* and *H. fernandica* from eggs to adults at a temperature range of 25^o - 28^oC were 8.0 ± 0.8 days and 15.6 ± 1.4 days, respectively. Adult life span of *C. chloropyga* was 29.8 ± 5.3 days and *H. fernandica* 29.8 ± 4.5 days. Ecological niches of the two flies are described with respect to their degrees of synanthropy and food preferences.

INTRODUCTION

Many non-biting flies have been implicated as mechanical vectors of human and other animal disease pathogens (Greenberg, 1964, 1973; Markus, 1980). The larvae of some calliphorids cause myiasis, a debilitating condition in humans and livestock (Zumpt, 1965; Greenberg, 1973; Service, 1980; Ogunniyi, 1981). Two calliphorids, *Chrysomya chloropyga* (Wiedemann) and *Hemipyrellia fernandica* (Macquart) were found to be very numerous in Akwa Ibom State, Nigeria (Ekanem, 1994). It was to establish the ecological significance of these two flies in the area that detailed studies of their development and bionomics were undertaken.

MATERIALS AND METHODS

Two calliphorid species *Chrysomya chloropyga* and *Hemipyrellia fernandica* were reared in netted cages, of which the least size was of 35 litre capacity. Cages were placed in cups of oil for protection from predatory ants, and access sleeves were provided at the sides. Floors of cages were covered with fine sand, about 4cm deep. Specimen cups (200ml) containing about 30gms of either beef liver or meat were placed in the cages for oviposition. This medium was replaced every third day with fresh ones. Other, rearing requirements (water, sugar, milk) were supplied as recommended by Greenberg and George (1985) and Laurence (1988). Colonies of *C. chloropyga* were started from identified gravid females netted from a refuse dump, and *H. fernandica* from egg batches collected from fresh beef meat. Egg batches were placed on rotting beef meat or liver, covered with tissue paper, and placed in separate cages. Oviposition time was noted; the eggs as well as subsequent larval instars examined at two - hourly intervals; and the pupae examined twice daily. Time intervals were noted for egg hatching, each instar, puparia, and eclosion. Other developments, such as onset of oviposition and mortality, were also noted. Rearing was done under natural light, and maximum and minimum temperatures in cages ranged between 25° to 28° C during the day. The sand on floor of cages was constantly moistened to maintain the relative humidity level inside cages at 58 - 89%.

Samples of eggs, instars, and pupae were preserved, after Greenberg and Szyska (1984). For detailed studies of cephalopharyngeal skeleton, spine bands and types, anterior and posterior spiracles, and arrangement of tubercles, samples of each instar were treated with boiling 10% KOH and preserved in glycerine.

There were nine replicate populations of each fly species, and each population was reared through three generations. A total of 27 replications per fly species were obtained. Developmental rates obtained are means and standard deviations calculated for the duration of each developmental stage from the 27 replications. Also, estimates of number of anterior spiracle branches, spiracular width, spiracular separation, eggs and puparia lengths, and distances between tubercles are means and standard deviations of the number of specimens used. Values obtained for distances between tubercles are available on request.

RESULTS AND DISCUSSION

Diagnostic Descriptions: *Chrysomya chloropyga* Egg: Creamy white in colour; mean length 1.6 ± 0.02 mm (n = 15), (Fig.1), (Greenberg & Singh, 1995).

First Instar: All segments completely encircled with spine bands (Fig.2) but spines on dorsum and laterad of segments 7 - 10 few, lateral fusiform areas present on segments 5 - 9. Cephalopharyngeal skeleton as in Fig.3; dorsal arch of tentorial phragma and ventral cornu weakly sclerotized.

Second Instar: Spine pattern similar to first instar; lateral fusiform areas from segments 5 or 6 to segment 9. Cephalopharyngeal skeleton as in Fig. 4; dorsal arch of tentorial phragma still weakly sclerotized; ventral cornu sclerotized and has a window.

Third Instar: Spine pattern same as first instar; lateral fusiform areas present on segments 6 - 9; spines pigmented, single and multi-pointed. Cephalopharyngeal skeleton as in Fig. 5; tentorial phragma extensively sclerotized. Anterior spiracles (Fig. 6) with 10 ± 0.3 branches (n = 16). Posterior spiracles (Fig.7) heavily sclerotized with incomplete peritreme; mean spiracular width 0.35 ± 0.03 mm (n = 20), and mean spiracular separation 0.21 ± 0.02 mm (n = 10). Distances between inner tubercles on the upper stigmal field (Fig 8) approximately equal to distance between the outer tubercles; distances between inner tubercles on the lower stigmal field approximately or slightly greater than distance between outer and median tubercles; distance between median and outer tubercles on the upper stigmal field approximately equal or slightly greater than distance between median and inner tubercles on the lower stigmal field; all tubercles except the inner ventrals with sclerotized tips and spinose bases.

Puparium: Cuticular features same as third instar; ventral surface flat (Fig.9); mean length 3.7 ± 0.2 mm (n = 12).

Hemipyrellia fernandica:

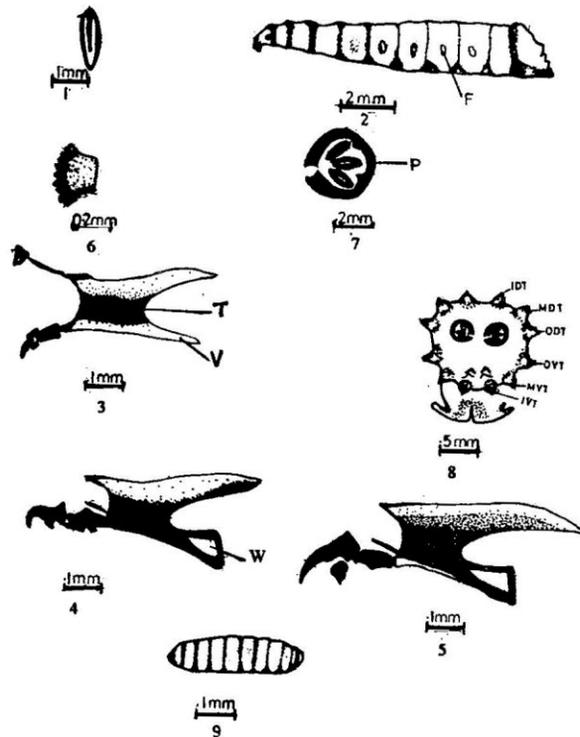
Egg: Creamy white; flanges diverge around the micropyle (Fig.10); mean length 1.67 ± 0.02 mm (n = 15).

First Instar: All segments encircled with spinose bands (Fig.11); segments 8 - 10 each encircled anteriorly with a single band, or with few spines scattered on dorsum and laterad; ventral spine bands double; anterior of segment 11 with more bands of spines. Cephalopharyngeal skeleton as in Fig. 12; dorsal arch of tentorial phragma weakly sclerotized.

Second Instar: Spine pattern similar to first instar. Cephalopharyngeal skeleton as in Fig. 13; sclerotization of the tentorial phragma extensive covering the dorsal arch; ventral cornu has a window.

Third Instar: Anterior of segments 2 - 7 completely encircled with spinose bands; spine bands on segments 8 - 10 restricted ventrad; spines pigmented and single - pointed. Cephalopharyngeal skeleton as in Fig 14; skeleton highly sclerotized. Anterior spiracles (fig. 15) have 8.9 ± 0.9 branches ($n = 20$). Posterior spiracles (Fig. 16) surrounded by complete peritreme with button; mean spiracular width $0.27 \pm 0.03\text{mm}$ ($n = 20$); and, mean spiracular separation $0.17 \pm 0.01\text{mm}$ ($n = 10$). Distances between outer dorsal and outer ventral tubercles (Fig. 17) greatest while distances between the median and outer tubercles on the dorsal stigmal field the least; distances between inner ventral, and between inner and median tubercles on the ventral stigmal the least; distances between inner ventral and between inner and median tubercles on the ventral stigmal field approximately equal to distances between outer and median ventral tubercles and slightly greater than distance between the inner ventral tubercles; distance between the inner dorsal tubercles slightly less than the distance between the outer dorsal and outer ventral tubercles.

Puparium: Cuticular features same as third instar (Fig. 18); mean length $3.6 \pm 0.12\text{mm}$ ($n = 10$).



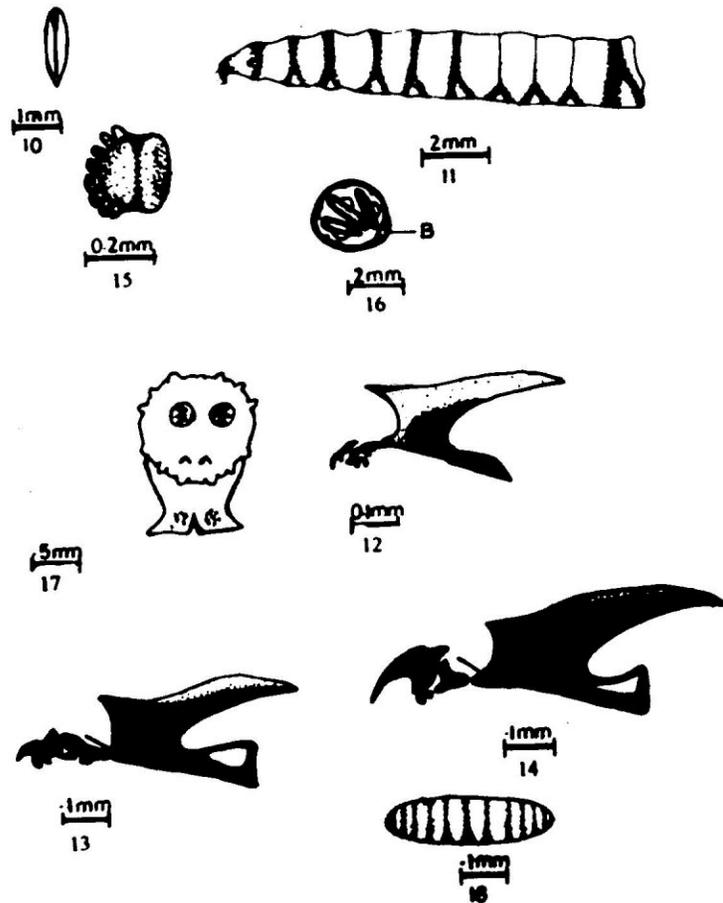


Fig: 1 – 9, *C. chloropyga*: fig. 1, Egg. Fig. 2, First instar larva, Fig. 3, cephalopharyngeal skeleton, first instar. Fig. 4, cephalopharyngeal skeleton, second instar. Fig. 5, cephalopharyngeal skeleton, third instar. Fig. 6, Anterior spiracle. Fig. 7, Right posterior spiracle. Fig. 8, posterior view, Fig. 9, puparium; F, fusiform area; D, dorsal arch; T, tentorial phragma; V, Ventral cornu; W, window; P, perittreme; IDT, Inner dorsal tubercle; IVT, Inner ventral tubercle; MDT, Median dorsal tubercle; ODT, Outer dorsal tubercle; OVT, Outer ventral tubercle; MVT, Median ventral tubercle.

Fig. 10 – 18, *H. fernandica*: Fig. 10, Egg. Fig. 11, First instar larva. Fig. 12, cephalopharyngeal skeleton, first instar. Fig. 13, cephalopharyngeal skeleton, second instar. Fig. 14, cephalopharyngeal skeleton, third instar. Fig. 15, Anterior spiracle. Fig. 16, left posterior spiracle. Fig. 17, posterior view. Fig. 18, Puparium. B, button.

Biology and Life History*Chrysomya chloropyga*:

The developmental rates of pre-adult stages of this fly are given in Table I. These are averages of 27 replicate rearings. Eggs were laid in clusters of 190 - 200 eggs per batch. Oviposition occurred both by day and at night (2200hrs - 0700hrs). Mean incubation time of egg was 12.4 ± 0.8 hrs. (n = 27 batches), (Table I). Flies preferred ovipositing in crevices of carcass. Developmental time for first instar was 13.2 ± 1.0 hr (n = 27 batches). At the end of the period, larva had reached average 3mm in length. Developmental time for second instar was 14.6 ± 0.5 hrs (n = 27 batches), and at the end of the period, larva measured 7 - 8mm in length. Durations of third instar, and post-feeding stage were 1.3 ± 0.2 days each. At the end of the third instar stage, larvae measured about 10mm in length, and having vomited out its gut contents found an object to attach and pupate. Pupal period lasted 3.9 ± 0.7 days (n = 27 batches).

Table 1: Developmental rates of *C. chloropyga* and *H. fernandica*

Stages	<i>C. chloropyga</i>	<i>H. fernandica</i>
Egg.	12.4 ± 0.8 h	10.3 ± 0.7 h
1 st instar	13.2 ± 1.0 h	11.9 ± 1.1 h
2 nd instar	14.6 ± 0.5 h	13.4 ± 1.7 h
3 rd instar	1.3 ± 0.2 d	2.2 ± 0.3 d
post - feeding larvae	1.3 ± 0.2 d	2.0 ± 1.3 d
Pupa	3.9 ± 0.7 d	9.9 ± 1.3 d
Egg-adult	8.0 ± 0.8 d	15.6 ± 1.4 d
First oviposition	6.1 ± 1.2 d	9.9 ± 1.7 d
Nos of batches/female	2.5 ± 0.5	2.3 ± 0.5
Adult Life span	29.8 ± 5.3 d	$29. \pm 4.5$ d

Values are means and standard deviations of 27 replications; hours (h); days (d).

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Table 2: Summary of non-biting flies taken in a survey from four environments of Akwa Ibom State, Nigeria in wet (W) and dry (D) seasons.

Flies	Eusynanthropic		Hemisyntrophic		Asynanthropic		Endophilic	
	W	D	W	D	W	D	W	D
Muscidae	472	513	559	801	508	124	87	193
Calliphoridae	1855	385	996	588	734	359	166	393
* <i>Chrysomya chloropyga</i>	(1807)	(375)	(930)	(568)	(724)	(351)	(156)	(393)
** <i>Hemipyrellia fernandica</i>	(45)	(8)	(53)	(14)	(10)	(8)	(10)	(0)
Phoridae	2	7	14	17	2	2	60	93
Neriidae	6	2	3	0	3	0	0	0
Sarcophagidae	17	6	44	15	22	2	3	
Piophilidae	18	7	15	45	3	4	1	8
Otitidae	1	2	2	10	42	28	0	1
Platystomatidae	18	15	156	12	309	204	8	0
Tephritidae	0	0	0	0	1	0	0	0
Micropezidae	1	0	1	1	10	2	0	0
Sepsidae	16	8	24	30	39	18	7	2
Diopsidae	0	0	1	0	0	0	0	0
Ephydriidae	0	0	0	7	0	0	0	0
Sphaeroceridae	440	26	492	204	62	7	27	8
Drosophilidae	508	260	570	443	228	99	435	551
Chloropidae	48	11	87	27	76	2	1	3
Fanniidae	7	5	8	1	5	0	2	0
Total	3409	1247	2961	2230	2050	872	796	1255

(Ekanem 1994)

**C. chloropyga* - totals in parenthesis

** *H. fernandica* - totals in parenthesis

According to Ekanem (1994), *C. chloropyga* is the most abundant non-biting fly in Akwa Ibom. It formed 39.2% (n = 9216) of total catches of the wet season, and 30.1% (n = 5604) of the dry season catches (Table 2). The synanthropic Index (51) of *C. chloropyga* was computed from data according to Nuorteva (1963). The fly is positively synanthropic in both wet (+44.7) and dry (+23.8) seasons, and prefers human settlements. Available data had showed a steep decrease in the number of *C. chloropyga* collected during the dry season, especially from eusynanthropic (urban) environments (Table 2). During the dry season, mean monthly air temperature in the area ranges from 26^o - 31^oC and mean monthly relative humidity at about 55%

(Moses, 1990). Most of the scanty vegetation in eusynanthropic environments are dried up so th shelters from the high air temperatures of the season become very few. Under these stressf conditions, *C. chloropyga* die off in large numbers in eusynsntropic environments.

Table 3: Summary of bait preferences of *C. chloropyga* and *H. fernandica* in a fly survey of fo environments of Akwa Ibom State, Nigeria in wet (W) and dry (D) seasons

Environments	Meat		Fish		Fruit		Human faeces	
	W	D	w	D	W	D	W	D
Eusynanthropic	801	140	748	179	229	1	29	55
	(18)	(0)	(21)	(6)	(1)	(92)	(5)	(0)
Hemisynanthropic	285	409	494	150	135	0	16	19
	(26)	(4)	(23)	(8)	(4)	(2)	(0)	(0)
Asynanthropic	347	141	320	200	0	0	57	10
	(6)	(1)	(3)	(5)	(0)	(0)	(1)	(2)
Endophilic	37	41	112	352	0	0	7	0
	(5)	(0)	(5)	(0)	(0)	(0)	(0)	(0)
Totals	1470	731	1674	881	364	1	109	74
	(55)	(5)	(52)	(19)	(5)	(4)	(6)	(2)

Ekanem(1994)

H. fernandica totals in parenthesis

In the wet season, the fly proliferates at a fast rate. At this time, the mean monthly temperature in the area ranges from 24^o - 26^oC (Moses, 1990), while the mean monthly relat humidity is about 77%. This favourable weather condition coupled with, a short life cycle o ± 0.8 days, first oviposition of 6.1 \pm 1.2 days later (Table 1), large number of eggs per ba. (190 - 200 eggs), and abundant food and oviposition sites from rotting organic waste heaps, *C. chloropyga* is almost everywhere.

According to Ekanem (1994) *C. chloropyga* did show a significant rejection of faeces during the dry season ($F = 6.0^*$; $P < 0.05$) (Table 3). Also, although there were no significant

rejection of faeces during the wet season, human faeces attracted the least number of flies (mean - 1470; fish - 1674; fruit - 364; human - faeces - 1090). For most times, *C. chloropyga* is a garbage and carcass feeder and breeder in this area. Its endophilic habit, coupled with its occurrence in large numbers makes it a potential pest of medical and forensic importance.

Hemipyrellia fernandica

Eggs were laid in batches of 180-200 eggs, but they were not heaped up as in *C. chloropyga*. Oviposition was observed only during the day, and the fly preferred ovipositing on fresh meat surfaces. Mean incubation period of eggs was 10.3 ± 0.7 hrs (n = 27 batches) (Table 1). Developmental time of first instar was 11.9 ± 1.1 hrs (n = 27 batches), and at end of period, larva measured 8.0 mm in length. Moulting into second instar occurred when larva was about 4mm in length. Developmental time for second instar was 13.4 ± 1.7 hrs (n = 27 batches), and at end of period, larva measured 8.0mm in length. Duration of third instar was 2.2 ± 0.3 days (n = 27 batches) at end of which period larva measured 12.0mm in length. It vomited out its gut contents and this made the larval medium to become foamy. The post-feeding stage lasted for 2.0 ± 1.3 days (n = 27 batches), and the larva burrowed into the sand to pupate. Pupal period lasted for 9.9 ± 1.3 days (n = 27 batches).

H. fernandica was observed on several occasions to oviposit on fresh meat surfaces indoors. Its ability to locate fresh carrion suggests a possible forensic significance as possibly one of the first flies to find and oviposit on a corpse. The Synanthropic Index (SI) of *H. fernandica* was computed from data according to Nuorteva (1963). The fly is positively synanthropic (+56.9 and + 23.3) in both wet and dry seasons, respectively (Ekanem, 1994). Additionally, Ekanem (1994) indicates that the fly showed preference for carcasses and had very little interest in human faeces (Table 3). Like *C. chloropyga*, *H. fernandica* lays large numbers of eggs per batch (180-200). The survey report (Ekanem, 1994) showed that *H. fernandica* comprised 1.3% (n = 9216) of the total wet season catches and 0.5% (n = 5604) of the total dry season catches (Table 2).

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REFERENCES

- EKANEM, M. S. 1994. Studies on the Synanthropic and non-biting flies (Diptera: Calliphoridae) of Akwa Ibom State, Nigeria. Unpublished Ph. D thesis, University Calabar, Nigeria pp 138 - 142.
- GREENBERG, B. 1964. Experimental transmission of *Salmonella typhimurium* by house flies to man. *American Journal of Hygiene*. 8: 149 - 156.
- GREENBERG, B. 1973, *Flies and disease, vol. 2. Biology and disease transmission*. Princeton University Press Princeton, New York. pp 447.
- GREENBERG, B. & M. L. SZYSKA. 1984. Immature stages and biology of fifteen species of Peruvian Calliphoridae (Diptera) *Annals of Entomological Society of America* 77: 488 - 517.
- GREENBERG, B. & J. GEORGE. 1985 *A handbook of insect rearing, vol. 2*, P. Sin & R. F. Moore (eds). Elsevier Science Publishers, Amsterdam.
- GREENBERG, B. & D. SINGH. 1995. Species identification of calliphorid (Diptera) eggs. *Journal of Medical Entomology*. 32: 21 - 26.
- LAURENCE, B. R. 1988. The tropical African latrine blowfly, *Chrysomya putoria* (Wiedemann). *Medical and Veterinary Entomology*. 2: 285-291.
- MARKUS, M. B. 1980. Flies as natural transport hosts of *Sarcocystis* and other Coccidia. *Journal of Parasitology*. 66: 361 - 362.
- MOSES, B. S. 1990. Studies and proposals for the development of Akwa Ibom State fisheries. *Akwa Agricultural Development Project (AKADEP)* pp. 15 - 17.

- NUORTEVA, P. 1963. Synanthropy of blowflies (Diptera: Calliphoridae) in Finland. *Annales Entomologici Fennici*. 29: 1 - 49.
- OGUNNIYI, I. O. 1981. Furuncular swelling caused by larva of *Cordylobia anthropophaga* in Kaduna, Nigeria. *Transactions of the Royal Society of Tropical Medicine and Hygiene*. 78: 782.
- SERVICE, M. W. 1980. *A guide to Medical Entomology*. Macmillan Press Ltd. London. pp. 226.
- ZUMPT, F. 1965. *Myiasis in man and animals in the old world*. Butterworths, London.