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Full Length Research Paper

Synanthropic indices and baits preferences of common non-biting flies (Diptera: Cyclorrhapha) of Akwa Ibom State, Nigeria

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Non-biting fly surveys in urban, rural, and forested areas of Akwa Ibom State, Nigeria, using rotten meat, fish fruits and human faeces, for collection yielded 4290 and 2474 flies from 9 families in the wet and dry seasons, respectively. Synanthropic Indices (SI) of 15 species were calculated for the wet season, of which 10 species were positively synanthropic, and five negatively synanthropic to human settlements. In the dry season, the SI of all the 9 species computed were positive for human settlements. Significant bait preference was shown only in the wet season by *Chrysomya albiceps* (F=10.2+++; p < 0.05) for rotten meat, and *Poecilosomella angulata* (F+9.6+++; p < 0.05), for human faeces. *C. albiceps* formerly rare in the area was the most abundant species collected at 38.8% and 44.8% specimens in wet and dry seasons, respectively.

Key words: Synanthropy, eusynanthropic, hemisynanthropic, asynanthropic, food sources.

INTRODUCTION

Non-biting flies are common insects found around public places such as the markets, abattoirs, refuse dumps, and even homes in Akwa Ibom State, of Nigeria. They feed and breed on organic wastes, and according to (Braack, 1986; Putman, 1977) are the principal invertebrate consumers of terrestrial carrion. This habit of feeding on decomposing organic materials which also include faeces and their synanthropic behaviour for human habitation make them important vectors of human enteric diseases (Greenberg, 1973). Like other insects, they are usually present at crime scenes and therefore in criminal investigations, could help the investigator estimate the post mortem interval (PMI), indicate where death had occurred, shed light on the causes and related circumstances of death, match a suspect with the scene of crime, and supply many more useful information related to a homicide case (Leccese, 2004).

In this study area, relatively little is known of these flies even though the area is within the Afrotropical Region where the calliphorids alone, according to (Rognes, 1998) comprise more than 330 species from 46 genera. Meanwhile, due to increased human activities in the area, much of the tropical rainforest has been reduced to either a savannah type or given way to human settlements. These changes are bound to affect animal species in the area. For instance, a calliphorid fly, *Chrysomya albiceps* (Wiedemann) has recently invaded the area. Knowing the antecedents of this fly elsewhere (Hanski, 1977; Guimarae and do Prado, 1979; Baumgartner and Greenberg,1984) there will be disruption of the native carrion community of this area and the consequences are uncertain. There is a need for stock-taking of insect fauna of the area. This study was therefore to identify the common synanthropic non-biting flies of the area, their bait preferences, synanthropic indices, and seasonal effect on their synanthropy.

MATERIALS AND METHODS

Study area

Akwa Ibom State is situated in the South eastern corner of Nigeria, between Longitude 8.30' and 7.30'E and Latitudes 4.30' and 5.30'N (Figure 1). The climate is tropical with two seasons, the dry and wet

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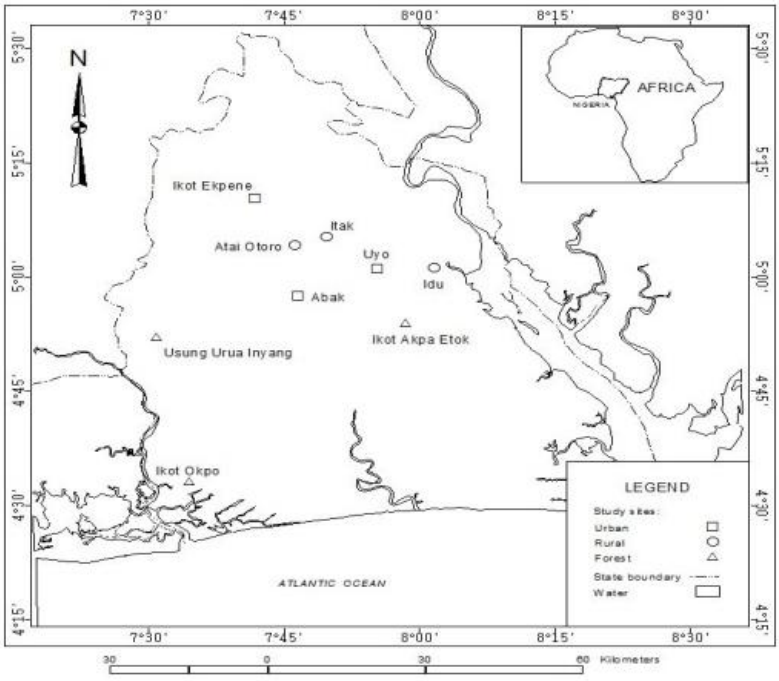

Figure 1. Location of study areas on the map of Akwa Ibom State, Nigeria.

seasons. The dry season is from November to March, and the wet season from April to October. The vegetation was originally of the tropical rainforest, but much of this native vegetation has been affected by human population pressure so that what now remains are farmlands with oil palms and immature forests.

The terms, eusynanthropic (urban), hemisynanthropic (rural), and asynanthropic (uninhabited) (Baumgartner and Greenberg, 1985) are used to describe the flies' synanthropy with man.

Eusynanthropic environments

These are urban centres characterised with high human population and sparse vegetation. Three towns, Uyo, Ikot Ekpene, and Abak were sampled (Figure 1).

Hemisynanthropic environments

There are fewer human settlements here as compared with the urban areas. These are the rural environments and are also characterised with abundant trees, and bushes. Three villages Itak, Idu, and Atai Otoro were sampled.

Asynanthropic Environments

These are forested areas located at least 2 km from human settlements. Three such locations, Ikot Okpo, Usung Urua Inyang and Ikot Akpa Etok were sampled.

Procedure

At each site, four baited traps, each containing a bait weighing ½ kg of either rotten meat, fish, fruit, or human faeces, were placed on the ground, at least 4 meters apart. The trap was a modification of that of (Akan, 1987). Flies were collected at 2-h intervals from 8.00 am to 6.00 pm local time. Before each collection, the air temperature was taken with a uniscope thermometer, while the relative humidity was measured with a wet and dry bulb hygrometer. Trapped flies were picked out into killing bottles, containing cotton wool soaked in chloroform. Each site was sampled twice each season. Flies collected were labelled, recorded and preserved. Preserved specimens were sent to the Insect Museum, Institute of Agricultural Research, Ahmadu Bello University, Zaria, Nigeria for identification.

The Synanthropic Indices (SI) were calculated (Nuorteva, 1963). SI ranged between +100 for the highest degree of synanthropy and -100 for the highest degree of avoidance;

$$2a+b-2c/2=SI$$

Where, **a** is the percentage of specimens of a given fly species trapped in urban settlement relative to all the specimens of this species collected by comparable trapping methods in this study area concerned at three observation stations, one of which is situated in urban settlement, one in the rural surroundings, and one in the wild; **b** is the respective percentage of specimens trapped at a house in the rural area and **c** is the percentage of specimens trapped from uninhabited areas Bait preferences were determined by Analysis of variance (ANOVA).

RESULTS

The mean air temperatures and relative humidity records taken at the experimental sites are shown in Table 1. Readings show no significant seasonal changes in temperature and relative humidity. The survey yielded 4270 and 2474 flies in wet and dry seasons, respectively from nine families (Table 2).

Table 1. Average air temperatures and relative humidity records at sites during experimental periods.

Site	Ambient air temperature (°C)		Ambient RH %	
	Wet	Dry	Wet	Dry
Eusynanthropic	27.7 ±1.0	29.4 ±1.3	81	76
Hemisynanthropic	27.6 ± 1.0	28.5 ± 1.3	82	78
Asynanthropic	27.5 ± 0.9	29.9 ±1.4	81	79

Table 2. Non-biting flies collected in wet and dry seasons in Akwa Ibom State, and their Synanthropic Indices (SI).

Flie	Total		SI		
	Wet	Dry	Wet	Dry	Point
Muscidea					
H. chalcogaster (Wiedemann)	32	17	+68.8	+76.5	7.7
Musca domestica (Wiedemann)	157	173	+66.6	+72.00	5.4
M. sorbens (Wiedemann)	38	21	+43.4	+48.00	4.6
Atherigona sp.	288	337	-27.3	+32.5	59.8++
My. lenticeps (Thomson)	27	9	+33.3	-	
Calliphoridae					
Chrysomya albiceps (Wiedemann)	1665	1108	+9.9	+14.2	7.3
C. putoria (Wiedemann)	453	327	+43.8	+14.2	29.4++
Stomorhyna rugosa (Bigot)	52	2	-91.3	-	-
Hemipyrellia fernandica (Macquart)	16	-	+62.5	-	-
Sphaeroceridae					
Poecilosomella angulata (Thomson)	505	234	+53.3	+51.3	2.0
Platystomatidae					
Elassogaster vanderwulpi (Hendel)	57	1	-24.6	-	-
Rivellia sp.	1	-	-	-	-
Sarcophagidae					
Sarcophaga exuberans(Pandellè)	19	17	+47.4	+48.2	0.8
Drosophilidae					
Drosophila sp.	830	212	+52.1	+47.6	4.5
Zaprionus sp.	98	5	-53.1	-	-
Tephritidae					
Leucotaeniella sp.	29	-	-74.1	-	-
Bactrocera sp.	5	8	-	-	-
Sepsidae					
Sepsis femoriseta (Duda)	10	-	-	-	-
Ulidinae					
Physiphora smaragdina (Loew)	8	3	-	-	-
Totals	4290	2474			

Synanthropic Indices (SI) of samples less than 15 specimens were not computed. This was to avoid the complexities and variables inherent in a Synanthropic Index (Baumgartner and Greenberg, 1985). Because of small samples sizes, the SI of only 9 of the 19 species collected were computed for both wet and dry seasons, while those of another 6 species could only be computed for the wet season alone (Table 2). Positive synanthropy for human settlements was shown by 10 species in the wet season, while negative synanthropy was shown by 5 species (Figure 2). In the dry season, all the 9 species with samples over 15 specimens were positively synanthropic to human settlements (Figure 2).

Assuming a SI of > 20 points as significant, that is the mean point from SI of both wet and dry seasons (Baumgartner and Greenberg, 1985) a significant

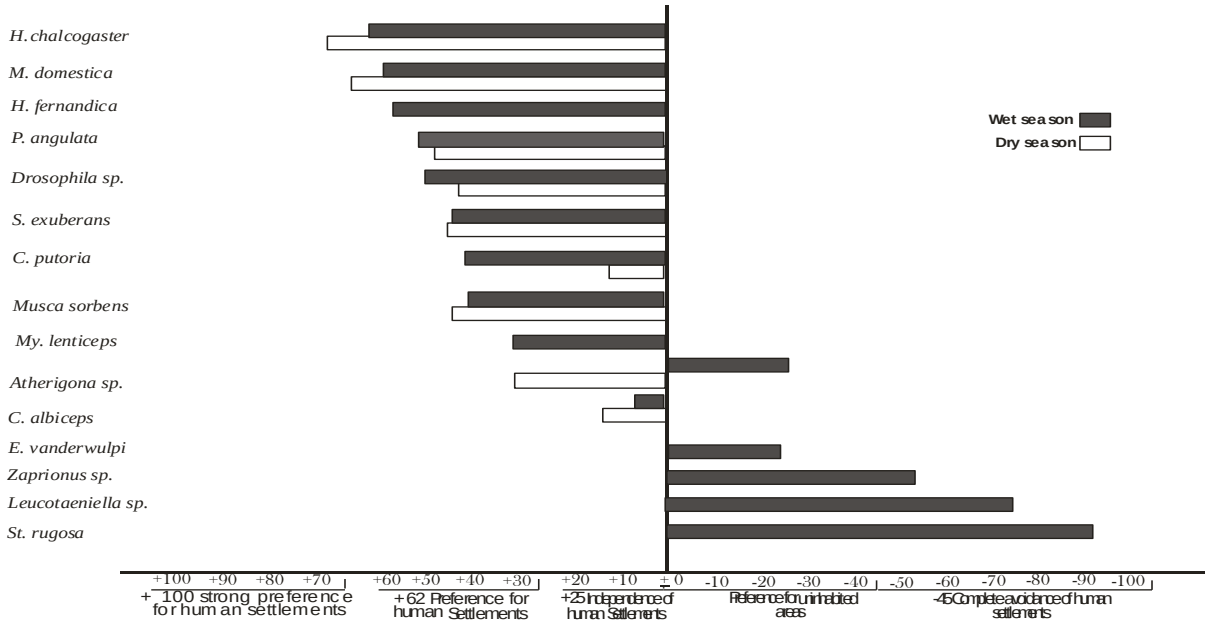

Figure 2. Synanthropic indices of some non-biting files of Akwa Ibom State, Nigeria and categorisation after Nuorteva (1963) in relation to hum an settlements.

increase in synanthropy △ SI = 59.8^{+} was shown by *Atherigona sp*., while *C. putoria* showed a significant decrease △29.4^{+} in synanthropy in the dry season. Seven species, *Hydrothaea chalcogaster,* △7.7, *C. albiceps* △7.3, *M. domestica* △5.4, *M. sorbens* △4.6, *Drosophila* sp. △4.5, *P. angulata* △2.0, and *S. exuberans* △0.8 showed no significant seasonal changes (Table 2).

Using the categorisation of Nuorteva (1963), two species *H. chalcogaster* (+68.8) and *M. domestica* (+66.6) showed strong preferences for human settlements in both wet and dry seasons (Figure 2). Preference for human settlements by *H. fernandica,* also showed (+62.5), *P. angulata* (+53.3), *Drosophila* sp. (+52.1), *S. exuberans* (+47.4), *C. putoria* (+43.8), *M. sorbens* (+43.4), and *My.lenticeps* (+33.3) in the wet season. In the dry season *P. angulata* (+51.3), *S. exuberans* (+48.2), *M. sorbens* (+48.0) and *Drosophila* sp. (+47.6) continued to maintain their preferences for human settlements. *C. albicpes* during both wet and dry seasons (+9.9, and +7.2, respectively) preferred environments independent of human settlements. *C. putoria* (+43.8) had showed a preference for human settlements in the wet season, but in the dry season, a significant decrease in synanthropy △29.4 had occurred and the fly showed a preference for environments independent of human settlements (Figure 2). Two species, *Atherigona* sp. (-27.3) sp. and *E. vanderwulpi* (-24.6) had preferred uninhabited areas in the wet season, but in the dry season, synanthropy of *Atherigona sp*. (+32.5) had increased significantly △65.7 for human settlements, (Figure 2). Because of small sample size, SI of *E. vanderwulpi* could not be calculated *Leucotaeniella* sp. (-74.1), and *S. rugosa* (-91.3) avoided human settlements in the wet season, and their dry season samples were less than 15 specimens.

Bait preferences of the 15 species analysed for SI are presented in Table 3. Species which showed significant preferences for the baits were *C. albiceps* for rotten meat in the wet season (F=10.2+++; P<0.05) and *P. angulata* for human faeces also in the wet season (F=9.6+++; P<0.05). Greater numbers of *Drosophila sp*. Zaprionus sp. and *My. lenticeps* were attracted to rotten fruits than to other baits (Table 3). Also noted to be attracted to faeces in greater numbers in the wet season where *S. rugosa* and *E. vanderwulpi* (Table 3), while *H. fernandica*, showed more preference for rotten meat.

DISCUSSION

The wet season in the study area, Akwa Ibom State of Nigeria is a more favourable period for non-biting flies than the dry season. This is because the relative humidity is higher and the air temperatures lower than during the dry season. The prevailing weather condition ensures that rotting organic materials which serve as breeding sites and as food sources for flies are abundant and long lasting. More fly species are available and in greater numbers in the wet season were in the dry season. The dry seasons, particularly in urban settlements (eusynanthropic) is a very stressful season for most flies in the area. Because of the higher air temperatures and lower relative humidity, rotting organic materials dry up rapidly, so that there is loss of food sources and breeding in the dry season. The species *Zaprionus* sp. (-53.1),

Table 3. Bait preferences of some common non-biting flies of Akwa Ibom State, Nigeria in wet and dry seasons.

Flie	Baits				
	Meat	**Rotten fish**	**Human faece**	**Rotten fruit**	**Total**
M. domestica	65(64)	56(87)	35(15)	1(7)	157(173)
M. sorbens	2(6)	24(12)	9(3)	3(-)	38(21)
Atherigona sp.	132(181)	88(126)	40(25)	28(5)	288(337)
My. lenticeps	1(-)	-	2(-)	24(9)	27(9)
C. albiceps	1044(780)	329(275)	90(53)	202(-)	1665(1108)
C. putoria	241(218)	142(106)	8(2)	62(1)	453(327)
H. fernandica	12(1)	2(-)	1(-)	1(-)	16(1)
S. rugosa	2(1)	5(2)	45(1)	-	52(4)
P. angulata	85(2)	8(-)	412(231)	-(1)	505(234)
E. vanderwulpi	4(-)	6(-)	47(-)	-	57(-)
S. exuberans	4(1)	2(1)	12(15)	1(-)	19(17)
Drosophila sp.	30(5)	120(25)	5(2)	675(180)	830(212)
Zaprionus sp.	-(1)	-(2)	-	98(2)	98(5)
Leucotaeniella sp.	1(-)	-	28(12)	-	29(12)
H. chalcogaster	8(4)	10(160)	8(4)	6(3)	32(17)

( ) Dry season data.

sites for flies. Also, vegetations which serve as resting sites dry up and flies become stressed, and there is high mortality of some species. Meanwhile, some species have become adapted to these stressful conditions by becoming more synanthropic to depend on humans for their sustenance. *Musca* species are cosmopolitan (de Carvalho et al., 2005) and as reported by several authors including Smith (1973) and Busvine (1980), show preferences for exposed environments. In the study *M. domestica*, *M. sorbens*, *H. chalcogaster* and *S. exuberans* had showed higher synanthropies during the dry season. These are omnivorous species which had showed no preferences for any food sources, but had become closer to man and depend on human wastes.

Following more detailed information on the identities of *C. chloropyga* and *C. putoria* (Rognes and Patterson 2005) the *C. chloropyga* of Ekanem (1994) was indeed *C. putoria*. *C. putoria* may be psychrophilic, for according to Ratte (1984) and Greenberg (1991), there is high mortality of immature stages of psychrophilic species when temperatures remain high during the dry season. Decrease in synanthropy of *C. putoria* is therefore linked with high mortality of its immature stages in eusynanthropic environments during the hot dry season. *C. albiceps* is observed to be a new comer into the area. Before the 1990s, when a similar survey (Ekanem, 1994) was conducted in the area, the species was rare. In that survey, *C. putoria* (then identified as *C. chloropyga*) had formed 39.2 and 30.1% of the total flies collected in wet and dry seasons, respectively. In the present study, while *C. putoria* formed 10.6 and 13.2%, respectively in wet and dry seasons, *C. albiceps* formed 38.8 and 44.8% respectively in the wet and dry seasons. It may be that *C. albiceps* is replacing *C. putoria* from this area as it did in Madeira and the Canary Islands (Hanski, 1977), Brazil (Guimarae and do Prado, 1979), and Peru (Baumgartner and Greenberg, 1984). While *C. putoria* had showed a significant decrease in synanthropy during the dry season, this new comer, *C. albiceps* shows some positive increase in synanthropy during the dry season. This may suggest increased population of this fly in future during the dry season in the area.

Atherigona sp. is a garbage feeder and shows preference for decaying baits (Uribe et al., 2010). In the wet season, it had avoided human settlements, but in the dry season, it showed a very significant synanthropy for human settlements. In the dry season, the asynanthropic environments are impoverished in terms of food sources. There is therefore high mortality of the species in asynanthropic environments during the dry season due to food shortages, while the fly populations in eusynanthrpic and hemisynanthrpic environments are maintained from garbage dumps in these environments.

Drosophila sp. is a positively synanthropic fly showing preference for human settlements during both wet and dry seasons. During both seasons, it had showed much preference for fruits only. Its decreased synanthropy in the dry season may be attributed to decrease in fruits, which is a feature of this period in this area.

P. angulata is a species which had showed a significant preference for faeces during the wet season. Its decreased synanthropy in the dry season may be due to drying up of breeding sites and food sources occasioned by low relative humidity of the dry season.

The species, *My. lenticeps* and *Zaprionus sp*. show some preferences for fruits, and the faeces loving species *E. vanderwulpi*, *S. rugosa*, and *Leucotaeniella sp.* were rare during the dry season, probably because of scarcity or

drying up of their food sources and breeding sites.

Conclusions

Most non-biting flies in the study area are positively synanthropic, especially during the wet season. Also, since most of these flies are omnivorous and survive on wastes from human settlements, the health implications of their closeness with humans in the area should be viewed with greater concern than what obtains presently.

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REFERENCES

Akan AB (1987). Synanthropy of non-biting flies in Awi Gmelina forest, Akamkpa, Cross River State, Nigeria" Department of Biological Sciences, University of Calabar, Nigeria.

Baumgartner DL, Greenberg B (1984). The genus Chrysomya (Dipteria:Calliphoridae) in the New World J. Med. Entomol. 21:105-113.

Baumgartner DL, Greenberg B (1985). Distribution and Medical Ecology of the Blowflies (Dipteria: Calliphoridae) of Peru. Ann. Entomol. Soc. Am. 78(5):565-586.

Braack IEO (1986). Arthropods associated with carcasses in the northern Kruger National Park. Suid-Africaanse Tydskvir vir Natuurnavvorsin.16:91-98.

Busvine JR (1980). Insects and Hygiene. Chapman and Hall. London.

de Carvalho CJB, Couri MS, Pont AC, Pamplona D, Lopes SM (2005). A catalogue of the Muscidae (Diptera) of the Neotropical Region. Zootaxa 860:1-282.

Ekanem MS (1994). Studies on the Synantropic and non-biting flies of Akwa Ibom State, Nigeria (Unpublished Ph.D Thesis, Department of Biological Sciences, University of Calabar, Nigeria.

Greenberg B (1973). Flies and Diseases, Biology and Disease Transmission. Princeton University Press, Princeton, New Jersey. 11

Greenberg B (1991). Flies as Forensic indicators. J. Med. Entomol. 28.565-577.

Guimarae J, Do Prado A, Buralli G (1979). Dispersal and distribution of three newly introduced species of Chrysomya Robineau-Desvoidy in Brazil (Dipteria:Calliphora)". Revista Brasileira Entomologia.23.245-255.

Hanski I (1977). Biogeography and Ecology of Carrion flies in the Canary Islands Ann. Entomologici Fennici. 43:101-107.

Leccese A (2004). Insects as Forensic Indicators; methodological aspects. Aggrawal's Internet J. Forensic Med. Toxicol. 5(1):26-32.

Nuorteva P (1963). Synanthropy of Blowflies (Diptera: Calliphoridae) in Finlaand. Ann. Entomologici Fenici. pp. 29:1-49.

Putman RJ (1977). Dynamics of the blowfly, Calliphora erythroceohala within carrion. J. Anim. Ecol. 46:853-866.

Ratte HT (1984). Temperature and Insect Development in K. H. Hofmann (Ed). Environmental Physiology and Biochemistry of Insects. Springer. Berlin.

Rognes K (1998). Family Calliphoridae. *In*: Papp L, & Davas B, (Eds.) Contributions to a manual of Palaearctic Diptera (with special reference to flies of economic importance). 3. Higher Brachycera. Science Herald, Budapest. pp. 617-648.

Rognes K, Patterson HEH (2005). Chrysomya chloropyga (Wiedemann 1818) and *C. Putoria* (Wiedemann 1830) (Diptera:Calliphoridae) are two different species. Afr. Entomol. 13(1):49-70.

Smith KGV (1973). Insects and other Arthropods of medical importance: The Trustees of the British Museum (Natural History) London.

Uribe-M N, Wolff M, De Carvalho CJB (2010). synanthropy and ecological aspects of Muscidae (Diptera) in a tropical dry forest ecosystem in Colombia. Revista Brasileira de entomologia. 54(3):462-547.