Population fluctuations of calliphorid species (Diptera, Calliphoridae) in the Biological Reserve of Tinguá, state of Rio de Janeiro, Brazil

Renata da Silva Mello[1], Margareth M. C. Queiroz[2] & Valéria M. Aguiar-Coelho[3]

1. Laboratório Eco-epidemiologia de doença de Chagas, Departamento de Biologia, Instituto Oswaldo Cruz, IOC/FIOCRUZ. Av. Brasil, 4365, Manguinhos, 21040-900 Rio de Janeiro, RJ. (mellorebio@yahoo.com.br; mmcqueiroz@ioc.fiocruz.br)
2. Departamento de Microbiologia e Parasitologia, Laboratório de Estudo de Dípteros, Universidade Federal do Estado do Rio de Janeiro. Rua Frei Caneca 94, Centro, 20211-040 Rio de Janeiro, RJ. (valeria@unirio.br)

ABSTRACT. The purpose of this work was to determine the diversity and population fluctuations of calliphorid flies in the Biological Reserve of Tinguá (ReBio-Tinguá), Nova Iguaçu, state of Rio de Janeiro, Brazil and to correlate their occurrence with the environmental variables of temperature, rainfall and relative air humidity. Specimens of Diptera were collected monthly between June 2002 and January 2005 using four traps placed at four points along a trail and exposed for 48 hours. The traps were baited with sardines and the trapped insects were stored in 70% alcohol. It was collected 8,528 calliphorids, thirteen species were identified among the blowflies including *Laneela nigripes* Guimarães 1977, *Chrysomya megacephala* (Fabricius, 1794)*, C. albiceps* (Wiedemann, 1819)*, C. putoria* (Wiedemann, 1830), *Chloroprocta idioidea* (Robineau-Devoidy, 1830), *Cochliomyia macellaria* (Fabricius, 1775), *Hemilucilia semidiaphana* (Rondani, 1850)*, H. segmentaria* (Fabricius, 1805), *Lucilia eximia* (Wiedemann,1819), *L. cuprina* (Wiedemann, 1830), *Paralucilia pseudolyrcea* (Mello, 1969), *Mesembrinella* sp. and *Eumesembrinella pauciseta* (Aldrich, 1922). No significant correlation was found between the abundance of blowflies and the temperature and relative air humidity. Only *C. megacephala* and *C. albiceps* showed a positive and significant correlation with rainfall. An analysis of grouping by month (UPGMA) revealed no seasonal difference in the composition of the community, indicating that the community of calliphorid flies is probably more influenced by the ecological niches occupied by each species than by the seasons of the year.

KEYWORDS. Seasonal abundance, diversity, Atlantic Forest, blowflies.

RESUMO. Flutuação populacional de califorídeos (Diptera, Calliphoridae) na Reserva Biológica do Tinguá, Rio de Janeiro, Brasil. O presente trabalho objetivou determinar a flutuação populacional de califorídeos da Reserva Biológica do Tinguá (ReBio-Tinguá), Nova Iguaçu, RJ e correlacionar sua ocorrência com as variáveis ambientais de temperatura, precipitação e umidade relativa do ar. Os dípteros foram coletados mensalmente entre junho de 2002 e janeiro de 2005 utilizando quatro armadilhas instaladas em quatro pontos de uma trilha e expostas por 48 horas. Como atrativo utilizou-se sardinha e os insetos capturados foram conservados em álcool 70%. Foram coletados 8.528 califorídeos; entre estes, foram identificados treze espécies incluindo *Laneela nigripes* Guimarães 1977, *Chrysomya megacephala* (Fabricius, 1794)*, C. albiceps* (Wiedemann, 1819)*, C. putoria* (Wiedemann, 1830), *Chloroprocta idioidea* (Robineau-Devoidy, 1830), *Cochliomyia macellaria* (Fabricius, 1775), *Hemilucilia semidiaphana* (Rondani, 1850)*, H. segmentaria* (Fabricius, 1805), *Lucilia eximia* (Wiedemann,1819), *L. cuprina* (Wiedemann, 1830), *Paralucilia pseudolyrcea* (Mello, 1969), *Mesembrinella* sp. and *Eumesembrinella pauciseta* (Aldrich, 1922). Não foi encontrada correlação significativa entre a abundância dos califorídeos e a temperatura e umidade relativa do ar. Somente *C. megacephala* e *C. albiceps* apresentaram correlação positiva e significativa com a precipitação. A análise de agrupamento dos meses (UPGMA) mostrou que não houve diferença na composição da comunidade em relação à sazonalidade, indicando que a comunidade de califorídeos é provavelmente mais influenciada pelos nichos ecológicos ocupados por cada uma das espécies do que pelas estações do ano.

PALAVRAS-CHAVE. Abundância sazonal, diversidade, Mata Atlântica, califorídeos.

The fluctuation and composition of animal population are influenced by the action of biotic and abiotic factors (Nuorteva, 1963; Dajoz, 1983). Thus, different populations of muscoids dipterous are governed by environmental variables and their populations altered according to the seasons (Fuller, 1934; Nuorteva, 1963; Vianna *et al*., 1998). Biotic factors can obscure the direct action of environmental variables on the rate of muscoids in the environment (Stewart & Roesler, 1942).

Over the last three decades, the population dynamics and spatial distribution pattern of wild muscoids species has undergone modifications in the Americas, especially through the introduction of exotic species of the genus *Chrysomya* Robineau-Desvoidy, 1830 and due to the action of anthropic factors. Studies have demonstrated that, as a result of anthropic effects, wild species have been found in urban environments (Wells, 1991), as well as synanthropic species in ombrophilous forests (Paraluppi & Castellón, 1994). Marinho *et al.* (2006) observed that changes in the surroundings of the Biological Reserve of Tinguá (ReBio-Tinguá), state of Rio de Janeiro, Brazil, such as garbage cans, houses, and disorderly garbage collection, may lead to local alterations in the faunal composition, evidenced by the presence of clearly urban species in the reserve. *Lucilia caesar* (Linnaeus, 1758) was found to have become extinct in the Canary Islands (Hanski, 1976), while *Cochliomyia macellaria* (Fabricius, 1805) has been suppressed in Peru (Baumgartner & Greenberg, 1984) and has shifted from urban to rural environments in Brazil (Guimarães *et al.*, 1979; d'Almeida & Lopes, 1983). These are a few indications of the high adaptability of invasive species.

This study attempted to determine the diversity of calliphorid flies in the ReBio-Tinguá to analyse the population fluctuations of the sampled species and correlating these fluctuations to variations in temperature, rainfall and relative air humidity.

MATERIAL AND METHODS

The Biological Reserve of Tinguá (22º28'- 22º39' S; 43º13'- 43º34' W) is located at the northern border of the Baixada Fluminense region (lowlands) with the Serrana region (mountains) in the state of Rio de Janeiro, about 70 kilometers from Rio de Janeiro city (MARINHO *et al.*, 2006). Most of this reserve is located in the municipalities of Nova Iguaçu and Duque de Caxias, in the Baixada Fluminense, but also covers parts of the municipalities of Petrópolis and Miguel Pereira, in the Serrana region. The reserve encompasses an area of 26,206 hectares covered with dense ombrophilous vegetation. The climate is tropical humid, with temperatures varying from 15.7 to 27.7°C.

The study took place in the area of the reserve located in the municipality of Nova Iguaçu, where four traps modified from FERREIRA (1978) were placed. This modification consisted of using a PVC pipe (15 x 14.7 cm) as the base of the trap, sealed with a transparent plastic container (17 x 14 cm) over the top (Fig. 1). To attract the dipterous, the traps were baited with sardines that had been allowed to defreeze in the refrigerator 24 hours before exposure in the field and were left in the study area for 48 hours. The insects were collected monthly from June 2002 through January 2005. The traps were placed at a height of 1.5 m from the ground along a trail located 268 m from the administrative office of the reserve, spaced about 100 m from each other. Each trap was set inside the vegetation, about 10 m from the edge of the trail. The trapped insects were killed and stored in 70% alcohol. They were identified and witness specimens were deposited in the entomological collection of the Instituto Oswaldo Cruz (IOC/ FIOCRUZ).

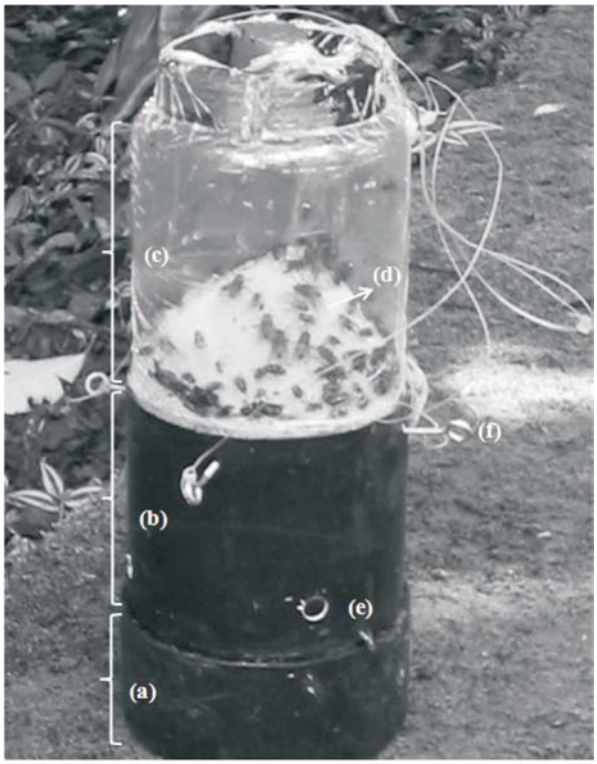


Fig. 1. Traps modified from FERREIRA (1978) to capture calliphorid flies (Diptera) in the Biological Reserve of Tinguá, RJ, Brazil. (a, PVC pipe as base of the trap where the bait is sets inside its; b, PVC pipe; c, transparent plastic container; d, inverted funnel made with nylon screen; e, orifices of dipterous entrance; f, hooks to hang the traps).

The abundance and frequency were calculated following MAGURRAN (1988). Temperature, rainfall and relative air humidity data were obtained from the Experimental Station of Itaguaí/PESAGRO-RIO, situated in the municipality of Seropédica, RJ, Brazil. Pearson's correlation analysis was applied to verify if occurs a functional relation between abundance of blowflies and environmental variables as temperature, rainfall and relative air humidity (ZAR, 1999). To avoid biased interpretations resulting from abundance differences, the data were transformed into the logarithm (x + 1), where x is the abundance value of blowflies (ZAR, 1999).

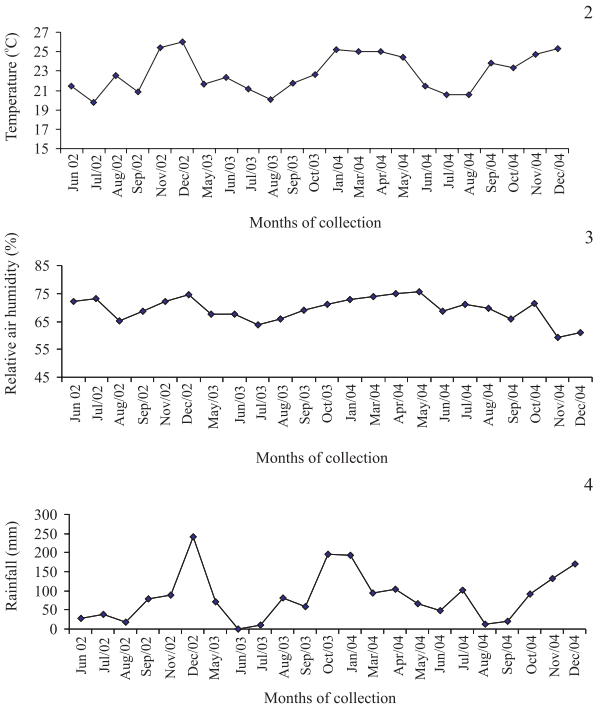
To ascertain whether the species were grouped seasonally, a quantitative grouping analysis of the trapping months was done based on the Manhattan distance (LEGENDRE & LEGENDRE, 1998). The UPGMA technique was also used to verify if the species grouped according to the type of habitat (ZAR, 1999). Both analyses were carried out using the Statistica software program, 1999 edition.

RESULTS

Along 24 months 8,528 calliphorids were collected. Thirteen species were identified among the blowflies and their absolute and relative frequency were calculated (Tab. I). Of the 13 species sampled, the one showing the greatest abundance and relative frequency was *Laneela nigripes* Guimarães, 1977 (N=1.721; F=20.18%), while the ones displaying the lowest values were *Eumesembrinella pauciseta* (Aldrich, 1922), *Lucilia cuprina* (Wiedemann, 1819) and *Paralucilia pseudolyrcea* (Mello, 1969), with frequencies less than 0.5%.

All species exhibited population fluctuations during the period of this study; the fluctuations of temperature, relative air humidity and rainfall are showed in Figs. 2-4. However none of the species presented significant correlations with the variables analysed (temperature, rainfall and relative air humidity), except for *Chrysomya megacephala* (Fabricius, 1794) and *C. albiceps* (Wiedemann, 1830), whose fluctuations showed a significant and positive correlation with rainfall (r= 0.524, p= 0.01; r= 0.441, p= 0.035, respectively). These species presented a representative population peak in December 2002 and their abundance declining sharply in the other months of collection (Fig. 5).

Laneela nigripes and *Mesembrinella* sp. were found in every collection month and the two species presented a similar population fluctuation (Fig. 6). *Laneela nigripes* showed population peaks in June and August 2002, May and July 2003, March, May and June 2004, while *Mesembrinella* sp. showed peaks in September 2002, May 2003, June and September 2004 (Fig. 6). *Hemiliucilia semidiaphana* (Rondani, 1850) was trapped with the highest frequency in August 2002, July and October 2003 and September 2004. *Lucilia eximia* (Wiedemann, 1819) exhibited population peaks in June 2003, September and October 2004 (Fig. 7). Unlike *C.*



Figs. 2-4. 2, Fluctuation of the average monthly temperature (°C); 3, relative air humidity (%) and 4, rainfall (mm) in the Biological Reserve of Tinguá, RJ, Brazil from June 2002 to December 2004.

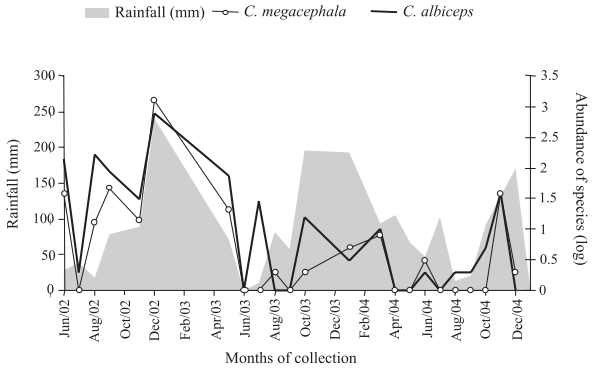


Fig. 5. Population fluctuation of *Chrysomya megacephala* (Fabricius, 1794) and *Chrysomya albiceps* (Wiedemann, 1819), abundance logarithm of (x+1), in relation to rainfall in the Biological Reserve of Tinguá, RJ, Brazil from June 2002 to December 2004.

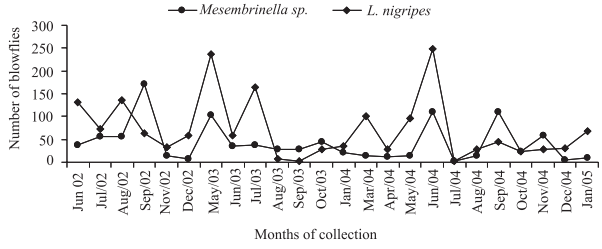


Fig. 6. Population fluctuation of *Laneela nigripes* Guimarães, 1977 and *Mesembrinella* sp. in the Biological Reserve of Tinguá, RJ, Brazil from June 2002 to December 2004.

megacephala and *C. albiceps*, the abundances of the other four species analysed showed no decline starting from 2003.

The quantitative grouping analysis of the trapping months indicated a division into two groups, one of them composed mostly of the months of 2002 and the other comprising a random grouping of the trapping months, without showing a definitive separation by season (Fig. 8). However, the UPGMA grouped the species according to the habitat most commonly occupied by them (Fig. 9).

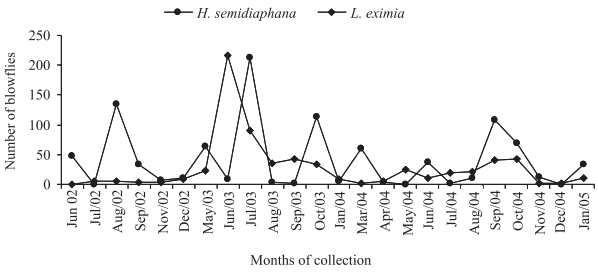
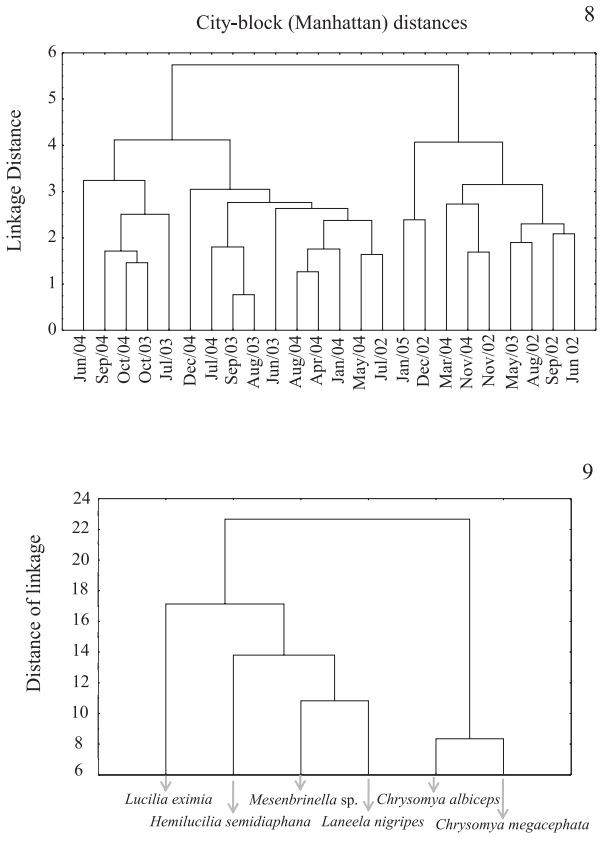


Fig. 7. Population fluctuation of *Hemilucilia semidiaphana* (Rondani, 1850) and *Lucilia eximia* (Wiedemann, 1819) in the Biological Reserve of Tinguá, RJ, Brazil from June 2002 to December 2004.



Figs. 8, 9. Quantitative Grouping Analysis (UPGMA) of the months (8) and trapped species (9) in the Biological Reserve of Tinguá, RJ, Brazil from June 2002 to January 2005, based on the Manhattan distance.

Table. I. Absolute and relative frequency of Calliphoridae species (Diptera) caught in the Biological Reserve of Tinguá, RJ, Brazil, from June 2002 to January 2005.

Species collected	Absolute frequency (N)	Relative frequency (F)
Laneela nigripes	1,721	20.18
Chrysomya megacephala	1,602	17.31
Chrysomya albiceps	1,477	18.78
Chrysomya putoria	76	0.89
Chloroprocta idioidea	494	5.79
Cochliomyia macellaria	64	0.75
Hemilucilia semidiaphana	1,026	11.64
Hemilucilia segmentaria	296	3.47
Lucilia eximia	655	7.68
Lucilia sericata	26	0.30
Lucilia pseudolyrcea	8	0.09
Mesembrinella sp.	1,046	12.26
Eumesembrinella pauciseta	37	0.43
Total	8,528	100.00

DISCUSSION

The population fluctuation of *C. megacephala* and *C. albiceps* was similar. They showed a positive and significant correlation with rainfall, confirming the data obtained from OLIVEIRA *et al.* (1999) and FERREIRA *et al.* (1995). However, PARALUPPI & CASTELLÓN (1994) found the highest occurrence of this genus during dry seasons in Manaus, state of Amazonas. In the present study, these species were more abundant in the months with the highest temperatures, with a population peak in December 2002, although no significant positive correlation was found with the rise in temperature, a finding also reported by other authors (GUIMARÃES *et al*., 1978; OLIVEIRA, 1982; SOUZA & LINHARES, 1997; MARINHO *et al*., 2003). Nevertheless, COSTA *et al.* (1992) and VIANNA *et al.* (2004) found the highest frequency of these species in state of Rio Grande do Sul in the months of March, April and May, which correspond to autumn. Thus, it can be seen that population fluctuations are not restricted to the influence of environmental variables, but can also be affected by biotic factors (HANSKI & KUUSELA, 1987). This probably would explain the high occurrences of these species at different seasons of the year, however it must be considered the distinct climatic characteristics between the studied regions.

One must consider the anthropic interference on the population oscillation of these species caused by the presence of homes, small farms and bars in the surroundings of the reserve. This fact favours the formation of accumulated garbage containing discarded food, rendering the environment favorable for the colonization of species with clearly urban habits (PARALUPPI & CASTELLÓN, 1994).

Despite confirmation of the anthropic effect on the collection site, the presence of the subfamily Mesembrinellinae was confirmed, whose nature is asynanthropic, i.e., it is totally averse to environments altered by humans and is restricted to ombrophilous forests (MELLO, 1967; D'ALMEIDA & LOPES, 1983). Within this group, *L. nigripes* was the most abundant and was trapped in every collection month. This species showed population peaks in the months when the temperature varied from 21.1 to 21.6°C, corresponding to the months of autumn and winter. A similar behavior was observed in *Mesembrinella* sp. with peaks in autumn, winter and spring, when the temperature varied from 20.9 to 23.8°C. The type of fluctuation in which a rapid periodic population growth is recorded, followed by a gradual decline, as was observed in these species, is seen in insects whose reproductive period is restricted to certain seasons of the year (SOLOMON, 1980).

Hemilucilia semidiaphana showed a population increase with declining temperature and relative air humidity, similarly to the findings of MARINHO *et al*. (2006) and RODRIGUES-GUIMARÃES *et al*. (2001). On the other hand, MOURA *et al.* (1997) found this species in a forested area in the hottest months of the year (spring and summer). This species is basically found in forested areas and was classified as asynanthropic by D'ALMEIDA & LOPES (1983); FERREIRA & BARBOLA (1998) and PARALLUPI & CASTELLÓN (1994).

Lucilia eximia displayed a higher population density in the months corresponding to winter and spring. A similar abundance of this species was not observed in the collection months, but its occurrence was recorded in all the months except June 2002. According to SILVA *et al.* (2003), *L. eximia* is a species apparently able to maintain a stable population size in modified environments when compared with other blowflies. It is a Neotropical and Nearctic species often present in rural and urban areas (PRADO & GUIMARÃES, 1982; D'ALMEIDA & LOPES, 1983; MADEIRA *et al*., 1989; PARALUPPI & CASTELLÓN, 1994; FERREIRA & BARBOLA, 1998; MARINHO *et al.,* 2003). According to D'ALMEIDA & ALMEIDA (1998), the broadest niche of *L. eximia* is in urban areas, followed by forested areas. The presence of this species in this study may be associated with the anthropization of the collection site, as well as the change in the population dynamics that it has undergone since the introduction of the genus *Chrysomya* in Brazil (PARALUPPI *et al.*, 1996).

With regard to the grouping analysis of the species, the genus *Chrysomya* clearly formed a group composed of so-called synanthropic species. The other group comprised strictly asynanthropic species, *Mesembrinella* sp. and *L. nigripes*, as well as species that are found in forested, rural or even urban environments, as in the case of *H. semidiaphana* and *L. eximia*. On the other hand, the grouping analysis per month indicated that there was no difference in the composition of the community in relation to the seasons of the year. This fact possibly indicater that the community of blowflies of the Biological Reserve of Tinguá was probably more influenced by the ecological niches occupied by each of the species than by the seasons.

Our results indicate that the presence of humans plays a predominant role in the distribution and diversity of muscoids species. This factor may influence the abundance of some species in detriment of others. It is important to emphasize that each species behaves in a manner peculiar to the different climatic conditions. The population dynamics and diversity of Diptera are affected not only by environmental variables but also by biotic

factors, by distinct breeding substrates, and by the direct influence of humans.

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