ECOLOGY, BEHAVIOR AND BIONOMICS

Seasonal Population Dynamics in *Lucilia eximia* (Wiedemann) (Diptera: Calliphoridae)

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**Dinâmica Populacional Sazonal em Lucilia eximia** (Wiedemann) (Diptera: Calliphoridae)

**RESUMO** - Neste estudo variações sazonais da fecundidade, tamanhos de asa e tíbia foram investigadas em populações naturais de *Lucilia eximia* (Wiedemann), na tentativa de determinar as alterações bionômicas da espécie, associadas à sazonalidade. Exemplares de *L. eximia* foram coletados mensalmente em Botucatu, SP, durante dois anos e as fêmeas adultas dissecadas para estimar a fecundidade. O tamanho do corpo foi estimado por medições de asa e tíbia. A fecundidade e o tamanho do corpo foram analisados sazonalmente. Uma trajetória temporal relativamente constante foi encontrada para fecundidade e tamanhos de asa e tíbia durante os 24 meses de estudo. Fortes correlações positivas entre tamanhos de asa e tíbia, fecundidade e tamanho de asa e tíbia foram observadas. A manutenção dos valores estáveis em *L. eximia* indica que a espécie sofreu pouca influência sazonal durante o período analisado. Esse resultado confirma o perfil demográfico e bionômico estável da espécie a despeito das variações climáticas sazonais observadas na área de estudo.

**PALAVRAS-CHAVE:** Mosca-varejeira, sazonalidade, fecundidade, tamanho corpóreo

**ABSTRACT** - In this study the seasonal variation of fecundity, wing and tibia sizes were investigated in natural populations of *Lucilia eximia* (Wiedemann) as an attempt to determine the variations in life history of the species associated to seasonality. Specimens of *L. eximia* were monthly collected in Botucatu, São Paulo, Brazil, during two years and the adult females dissected to estimate fecundity. Body size was estimated by measuring wing and tibia. Fecundity and body size were seasonally analysed. A relatively constant temporal trajectory was found for fecundity, wing and tibia size over twenty-four months. Strong positive correlations between wing and tibia size, fecundity and wing and fecundity and tibia were observed. The maintenance of stable values in *L. eximia* indicates that it has suffered little seasonal influence over the period analysed. This result confirms the demographics and life history stable profile of the species in spite of seasonal climatic changes observed in the study area.

**KEY WORDS:** Blowfly, fecundity, body size

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*Lucilia* Robineau-Desvoidy species are named greenbottles because of their brilliant metallic green coloration, which appears to vary with age (Smith 1986). However, the species of the genus *Lucilia* are also considered as blowfly, since they exhibit the same synanthropic and feeding behavior observed in other Calliphoridae species (Stevens & Wall 1996). Adults, especially males, are frequently found on flowers where they feed on the nectar (Smith 1986). Most species of *Lucilia* are saprophagous, breed in carrion and dung, usually being the first to appear in carrion in sunlight (Archer & Elgar 2003). In Brazil the most common *Lucilia* species is *Lucilia eximia* Wiedemann (Moura et al. 1997). *L. eximia* is a nearctic and neotropical species frequently found in rural and urban areas that breeds primarily in carcasses but also in rotten fruit and urban garbage (Madeira et al. 1989).

*L. eximia* has medical and veterinary importance because it causes secondary myiasis in humans and primary myiasis in animals (Madeira et al. 1989). Further, this species can be used in forensic medicine as a biological indicator in estimating the post-mortem interval (Moura et al. 1997). *L. eximia* has been reared in a wide variety of corpses, including pigs (Souza & Linhares 1997) and human bodies (Freire 1914).

Around 30 years ago, three species of Calliphoridae blowflies introduced into the Americas: *Chrysomya megacephala* Fabricius, *C. putoria* Wiedemann, and *C. albiceps* Wiedemann colonized several countries of South America including Brazil (Guimarães et al. 1978). This invasion resulted in a decline of *L. eximia* and another native American species, *Cochliomyia macellaria* Fabricius (Guimarães et al. 1978, Madeira et al. 1989). Although the
consequence of intraspecific competition for food among immature stages of Chrysomya spp. and C. macellaria species has received renewed attention from both theoretical and experimental standpoints (Godoy et al. 1996, 2001), very little is known about L. eximia (Silva et al. 2003), mainly with respect to its population dynamics.

Dynamic behavior is important in the assessment of relevant demographic aspects of biological invasions (Hengeveld 1989). However, dynamic behavior usually depends on factors associated to demography, such as growth rate and carrying capacity (Hengeveld 1989). The values of demographic parameters associated with population growth may exhibit high variation between different species and populations (Gotelli 1995). The causes of variation are usually diverse and depend on the environment and the biological attributes of each organism (Brewer 1994).

Fecundity, survival, developmental rate, weight and body size are generally density-dependent characters influenced by environmental factors in insect populations (James & Partridge 1998). Thus, it is possible that the population density of blowflies is strongly associated with seasonality, since competitive ability has been considered temporally different among species and populations (Reis et al. 1999).

In the present study the seasonal variation in fecundity, wing and tibia sizes in natural populations of L. eximia have been analysed as an attempt to contribute to the understanding of its population dynamics.

Material and Methods

Specimens of L. eximia were monthly collected from December 2000 to November 2002 in the vicinity of the campus of the São Paulo State University located at Botucatu, São Paulo State, Brazil. Adult flies were maintained under laboratory conditions in cages (30 cm x 30 cm x 30 cm) covered with nylon at 25 ± 1°C, being fed water and sugar ad libitum. Adult females were fed fresh liver to permit complete development of the gonotrophic cycle (Linhares 1988). Females were dissected and the number of eggs was recorded. Body size was estimated by measuring right wing and second tibia length of the flies. Seasonal fecundity, wing and tibia sizes were compared by one-way ANOVA. Pearson’s coefficient was used to analyse the correlation between life-history parameters. Mean monthly temperatures and humidities for the Botucatu area were obtained from the Meteorological Station of São Paulo State University at Botucatu, São Paulo State.

Results and Discussion

L. eximia exhibited a relatively stable temporal trajectory for fecundity, tibia and wing length over twenty-four months (Figs. 1-3). There was no significant correlation between temperature and fecundity or wing length or tibia length (P > 0.05), but there was highly significant correlation between wing length and fecundity (r = 0.73, P < 0.05), tibia length and fecundity (r = 0.63, P < 0.05) and, tibia and wing lengths (r = 0.72, P < 0.05). No significant correlation between humidity and fecundity or body size has been found (P > 0.05).

The weak oscillations found for fecundity, wing and tibia length indicate that these three characters are relatively constant over the year, suggesting weak impact of seasonal effects. Reigada & Godoy (2005) have also observed this result in a similar study with C. megacephala; however, positive correlations between fecundity and body size and body size and temperature have been observed in natural populations of the species. The difference in terms of correlation between the life history characters of L. eximia and C. megacephala might be explained by the abundance patterns inherent in each species, since L. eximia has been found throughout the year in spite of temperature changes (Moura et al. 1997, Reigada & Godoy 2005).

Of all biological parameters directly associated with growth rate in blowflies, fecundity plays an important role in population dynamics since it determines the population growth potential (Godoy et al. 1996, 2001). The dynamic behavior of blowflies has been analysed by mathematical models with results revealing that the stability of population equilibrium depends essentially on survival and fecundity (Godoy et al. 1996, 2001; Silva et al. 2003). Using bifurcation theory to perform a parametric sensitivity analysis, Godoy et al. (1996) observed that the variation of fecundity and survival produces qualitative changes in population dynamics of C. macellaria, C. megacephala and C. putoria. These species exhibit changes from stable equilibrium to a two-point limit
In fecundity of natural blowflies, nevertheless, nothing is known about the seasonal variations that are apparently real in natural populations (Ullyett 1950), and the annual variation in the incidence of the Calliphorid species in the region of Campinas, State of São Paulo, and showed that *L. eximia* was relatively abundant throughout the year long, exhibiting a much more stable population size than *Chrysomyia* species or *C. macellaria*.

We have been pursuing the population ecology line with *L. eximia* and other blowflies, focusing mainly on population dynamics (Silva et al. 2003) and intra and interspecific interactions (Rosa et al. 2004) and we believe that the information that we have gathered will help to elucidate the mechanism and processes taking place in this case of biological invasion by *Chrysomyia* species.

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