# SYNANTHROPY OF CALLIPHORIDAE (DIPTERA) IN PELOTAS, RIO GRANDE DO SUL STATE, BRAZIL.

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SUMMARY: To determine the Synanthropic Index of Calliphoridae species occurring in the Municipality of Pelotas, RS, Brazil, six Wind Oriented Traps (W.O.T.) were placed in three distinct ecological areas: urban, rural e uncultivated, according to NUORTEVA (1963). At each site two traps were placed: one with decayed cattle liver and the other one with decayed chicken viscera, from February, 1993 to January, 1995. Thirteen calliphorid species were caught and classified in three groups, according to mean occurrence frequency at different ecological areas, *i. e.*, species with preference of urban areas, *L. cuprina*, *C. megacephala*, *L. sericata* and *C. vicina*, species with independence of urban areas, *S. chlorogaster* , *L. eximia*, *H. semidiaphana*, *C. lopesi*, *C. albiceps*, *C. putoria*, *C. macellaria* and *C. hominivorax* and only one specie adapted to uncultivated areas, *P. xanthogeneiates*. Most of the species prefer an antropobiocenosis or agrobiocenosis. *L. cuprina* presented the highest degree of synanthropy (S. I.= +79,10) and *P.xanthogeneiates* was the only non-synanthropic species (S. I.= - 84.65). Among the eussinanthropic species, *C. megacephala* presented the highest populational density.

KEY-WORDS: Calliphoridae, Diptera, synanthropy.

## *INTRODUCTION*

The association of muscoids with the human environment now is important. Such an association, due mainly to the changes in natural ecosystems, which determine the shift of species from a eubiocenosis to a agrobiocenosis or to a antropobiocenosis, enhance the risks of pathogen transmission to human and domestic animals.

Several authors studied synanthropy, some dealing with purely ecological aspects (FRANKIE & EHLER, 1978), other focusing on the facultative or obligatory association with man (GREGOR & POVOLNY, 1958; DEBERNEVA-UKHOVA, 1962; NUORTEVA, 1963, 1966; POVOLNY, 1971). Notwithstanding, ZUMPT (1965) considered as synanthropic only the muscoids of public health or economical importance.

NUORTEVA (1963) classified as synanthropic the muscoids showing the ability to use suitable conditions supplied by the human environment, and by doing so, stated the concept of the Synanthropic Index (S.I.), used to evaluate the relationship between calliphorids and man, as well as their preference for colonized areas. This index is estimated by quantitative data (percentages) of the occurrence of a given species in three different ecological areas: urban, rural e uncultivated, using always the same collection procedures.

According to POVOLNY (1971), synanthropic flies can be classified based on their bionomia and behavior, and taking also in count ecological, economical and public health aspects. Therefore species that are almost totally dependent on the human environment, the antropobiocenosis, are said to be eusynanthropic. Those species independent of an antropobiocenosis but that live in intermediate environments (between wild and human) are hemissinanthropic. Finally, those which live in natural ecosystems, independent of an antropobiocenosis or an agrobiocenosis, are assinanthropic.

The prevalence of different species of synanthropic muscoids (mainly calliphorids) and their populational density varies with geographical area, climate and food supply (NUORTEVA, 1963; FERREIRA, 1975, 1978; LINHARES, 1981 and BRACK *et alii*, 1987.

FERREIRA (1983) studied the synanthropy of calliphorids in Goiânia, Goias State, central Brazil, using three different baits (raw fish, bird liver and human feces). Seven species were captured: *Chrysomya chloropyga* (= *C. putoria*) *Cochliomyia macellaria*, *Hemilucilia segmentaria*, *Myiolucilia fulvinota*, *Phaenicia eximia* e *Phaenicia sericata* (*Phaenicia* = *Lucilia*). Of these, *C. putoria* showed the highest synanthropic index (+88.0), and *H. flavifacies* (= *H. semidiaphana*) showed the highest degree of assinanthropy (-100.0).

LINHARES (1981), at Campinas, São Paulo State, Brazil, studied the synanthropy of calliphorids using three different baits (chicken viscera, human feces and rat carcasses). The following species were captured: *C. macellaria*, *L. cuprina*, *L. eximia*, *C. albiceps*, *C. megacephala*, *C. putoria*, *H.segmentaria*, *H. flavifacies* (= *H. semidiaphana*), *Myiolucillia lyrcea* e *Paralucilia* sp. Among these *L. cuprina* presented the highest synanthropic index (+83.5), and *M. lyrcea* showed the highest degree of assinanthropy (S.I. = -100.0).

According to STEVENS & WALL (1996), who studied 25 *Lucilia* species, using 14 characteristics commonly employed for identify species of this genus, concluded that *P. eximia*, *P.sericata* and *P. cuprina* belong to *Lucilia* genus.

The present work was aimed at the identification of Calliphoridae species captured in the Municipality of Pelotas, Rio Grade do Sul State, Brazil, with the help of Wind Oriented Traps (W.O.T.), as well as the estimation of their synanthropic indexes, as defined by NUORTEVA (1963).

## MATERIALS AND METHODS

The calliphorids were captured with the help of six Wind Oriented Traps W.O.T., prepared in the urban, rural and uncultivated areas of the county of Pelotas, from February / 93 to January /95.

The traps were hand made following the model of BROCE *et alii* (1977), modified by OLIVEIRA (1980).

Two traps were prepared in each ecological area, being separated by a distance of 30 m and , suspended 1.20 m above the ground. A plastic recipient (diameter 11 cm and depth 7 cm), containing 250 grams of decayed cattle liver, was placed in one trap of each area. The other trap received a bait made of decayed chicken viscera. Water was added to both traps to provide humidity. Before use, baits were kept in glass vessels at room temperature, for five to seven days, in order to speed up the beginning of the decaying process.

The traps stayed on the same spot throughout the whole experiment. The diptera were collected twice a week, when 50% of the bait was changed and the water level was refilled, in order to keep the attraction ability unaltered.

Collections were made simultaneously in all three areas, urban, rural and uncultivated, with a total of 576 samples. The calliphorids were previously killed with a pyrethroid insecticide, being then put in individual vials by trap and collection site, and finally taken to the laboratory for identification and counting.

Calliphorid identification was carried out to the species level, with the help of a stereomicroscope, according to CUSHING & HALL (1937), JAMES (1947), MELLO (1961, 1962, 1968, 1972ab), DEAR (1985) and STEVENS & WALL (1996).

The estimation of the synanthropic index (S.I.), that ranges from + 100 to - 100, was based upon the formula of NUORTEVA (1963), as follows:

$$S.I. = \frac{2a + b - 2c}{2}$$

where:

a= Percentage of individuals from a given species collected in the urban area;

b= Percentage of individuals from a given species collected in the rural area;

c= Percentage of individuals from a given species collected in the uncultivated area, using the same collection method for all ecological areas.

Based also in the criteria of NUORTEVA (1963), the monthly mean variation of the synanthropic index for all species was calculated.

The statistical analysis of the difference between mean numbers found for each species in the three distinct areas was performed using the Duncan test (a= 0.05).

## RESULTS

Throughout the trial, 409,924 calliphorids were captured in the six traps used.

The species found, and their respective frequencies, are listed in the Table 1. It can be see that *C. albiceps* represented 64.62% of the calliphorids collected, followed by *C.megacephala* with 19.68%, both summing up to 84.30% of the total number of calliphorids captured. The species *C.vicina*, *P. xanthogeneiates* were less represented, totalizing only 0.1% of the specimens.

In the Table 2, it is observed that the highest frequency for calliphorids occurred in the urban area - 36.8%. If the urban and rural area were considered together, as the environment modified by man, the frequency is then 65.9%. The preference for urban areas, the antropobiocenosis, was patent for *C.megacephala*, *L. sericada*, *L. cuprina* e *C. vicina*, while *P.xanthogeneiates* showed a preference for uncultivated areas. The remaining species did not present a preference for any

particular area. The results for mean numbers of each species in the comparison between the three areas, regardless of the bait used, were analyzed by the Duncan test (a =0.05) and are presented in the Table 3.

Table 1 - Frequencies of *Calliphoridae* species from February/93 to January/95, in Pelotas, RS.

| Species | Frequencies | |
|---|---|---|
| | Absolut | Relative (%) |
| *Cochliomyia hominivorax* | 1734 | 0.42 |
| *Cochliomyia macellaria* | 11765 | 2.88 |
| *Chrysomya albiceps* | 264494 | 64.62 |
| *Chrysomya putoria* | 3840 | 0.94 |
| *Chrysomya megacephala* | 80671 | 19.68 |
| *Sarconesia chlorogaster* | 1214 | 0.30 |
| *Lucilia eximia* | 18304 | 4.46 |
| *Lucilia sericata* | 11866 | 2.90 |
| *Lucilia cuprina* | 345 | 0.08 |
| *Calliphora lopesi* | 3412 | 0.83 |
| *Calliphora vicina* | 174 | 0.04 |
| *Hemilucilia semidiaphana* | 11842 | 2.89 |
| *Paralucilia xanthogeneiates* | 263 | 0.06 |
| Total of Calliphoridae | 409924 | 100.00 |

Table 2 - Frequencies of *Calliphoridae* species captured in three ecological areas, from February/93 to January/95, in Pelotas, RS.

| Species | Relative Frequencie by area (%) | | |
|---|---|---|---|
| | Urban | Rural | Uncultivated |
| *Cochliomyia hominivorax* | 12.8 | 30.5 | 56.6 |
| *Cochliomyia macellaria* | 24.6 | 32.6 | 40.9 |
| *Chrysomya albiceps* | 29.5 | 28.7 | 41.7 |
| *Chrysomya putoria* | 26.4 | 25.1 | 48.5 |
| *Chrysomya megacephala* | 59.4 | 30.7 | 9.8 |
| *Sarconesia chlorogaster* | 43.0 | 25.5 | 31.5 |
| *Lucilia eximia* | 36.8 | 30.1 | 33.0 |
| *Lucilia sericata* | 61.3 | 23.0 | 15.6 |
| *Lucilia cuprina* | 69.5 | 26.6 | 3.7 |
| *Calliphora lopesi* | 30.6 | 34.9 | 34.4 |
| *Calliphora vicina* | 50.6 | 32.1 | 17.2 |
| *Hemilucilia semidiaphana* | 37.2 | 28.6 | 34.2 |
| *Paralucilia xanthogeneiates* | 4.5 | 4.1 | 91.2 |
| Total of Calliphoridae | 36.7 | 29.2 | 34.1 |

The synanthropic indexes for species of Calliphoridae family are depicted in the Figure 1. Three distinct groups can be seen: one with S.I. ranging from +79.10 to +49.45 (*L. cuprina*, *C.megacephala*, *L. sericata* and *C. vicina*) and with clear preference for inhabited areas; an intermediate group with S.I. ranging from +24.20 to -28.55 (*S. chlorogaster*, *L. eximia*, *H.semidiaphana*, *C. lopesi*, *C. albiceps*, *C. macellaria*, *C.putoria* and *C. hominivorax*) and without preference for any particular area; and a third group with only one species (*P. xanthogeneiates*) with S.I. of -84.65 and showing a preference for uncultivated areas.

The interpretation of the S.I. depicted in the Figure 1, was based on the statistical analysis (Duncan test - a = 0.05), as appears on Table 3. The significant differences of the mean numbers of each species in the comparison between the three areas are represented.

The monthly variation of the S.I. for calliphorid species, described in sequence, are depicted in the Figures 2, 3, 4, 5 and 6.

Table 3 - Duncan test analysis (a = 0,05) of means numbers of Calliphoridae species ecological areas, captured from February/93 to January/95, in Pelotas, RS.

| Species | Ecological Areas | | |
|---|---|---|---|
| | Urban | Rural | Uncultivated |
| *Cochliomyia hominivorax* | 2.42a | 4.87a | 8.62a |
| *Cochliomyia macellaria* | 19.92a | 29.23a | 31.66a |
| *Chrysomya albiceps* | 819.53a | 791.47a | 1001.83a |
| *Chrysomya putoria* | 7.47a | 8.16a | 12.92a |
| *Chrysomya megacephala* | 405.63a | 214.18ab | 97.31ab |
| *Sarconesia chlorogaster* | 6.85a | 4.60a | 4.18a |
| *Lucilia eximia* | 89.92a | 61.66a | 76.15a |
| *Lucilia sericata* | 111.41a | 34.95b | 18.02c |
| *Lucilia cuprina* | 2.78a | 1.14b | 0.18c |
| *Calliphora lopesi* | 12.18a | 13.49a | 12.09a |
| *Calliphora vicina* | 1.11a | 0.62ab | 0.31b |
| *Hemilucilia semidiaphana* | 28.53a | 27.47a | 33.30a |
| *Paralucilia xanthogeneiates* | 0.15a | -0.00a | 2.59b |

Means on the same row followed by different letters are significatively different. Data transformed in SQR of (X + 0,5)

*C. hominivorax* and *C. macellaria* presented a S.I. of - 28.55 and +1.80, respectively. Such values ranged throughout the year as is stated in the Figure 2, from - 100 to +50.0 and from - 66.27 to + 100, respectively.

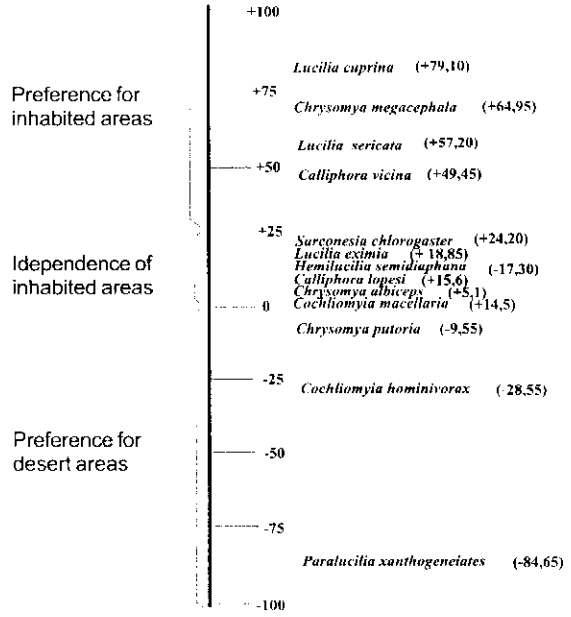


Fig. 1 - Diagram of the synanthropic indexes of the Calliphoridae species captured with W.O.T. traps, from February/93 to January/95, in Pelotas, RS.

*C. albiceps*, *C. putoria* and *C. megacephala* presented S.I. values of + 12.15, -9.55 and +64.95 respectively (Figure 1). It can be seen in Figure 3 that these indexes varied throughout the two years trial. For *C. albiceps* it ranged from -86.76 to +57.17, for *C. putoria* from -100 to + 100. *C. megacephala* has varying indexes, but only with positive values, except in December/94 with -19.95.

*L. eximia*, *L. sericata* e *L. cuprina* presented S.I. values of + 18.85, +57.20 and +79.1 respectively (Figure 1).The indexes

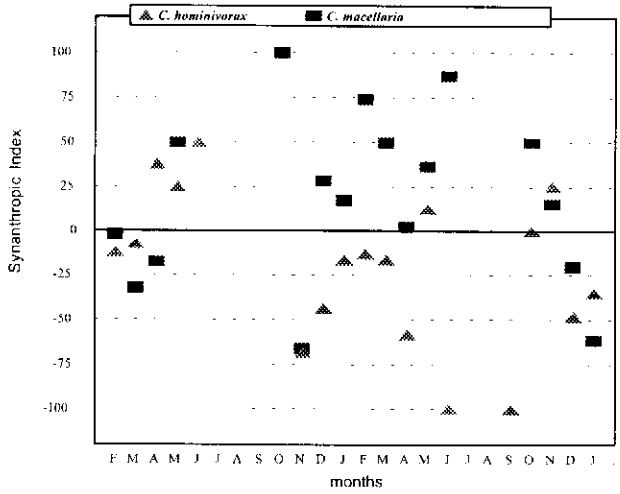


Fig. 2 - Monhtly variation of the synanthrópic index for *Cochliomya* species, from February/93 to January/95, in Pelotas, RS.

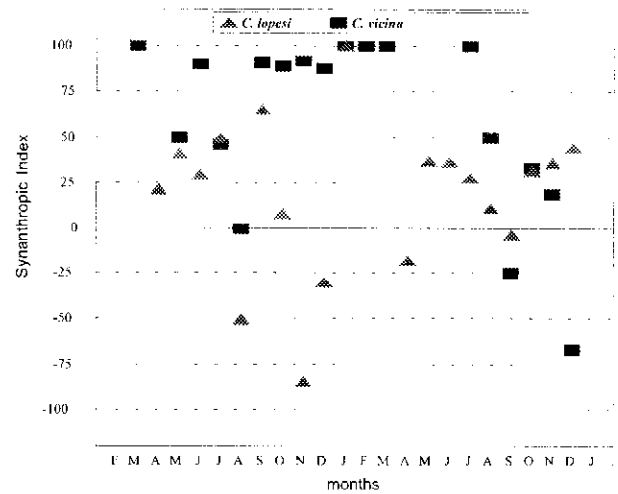


Fig. 5 - Monhtly variation of the synanthrópic index for *Calliphora* species, from February/93 to January/95, in Pelotas, RS.

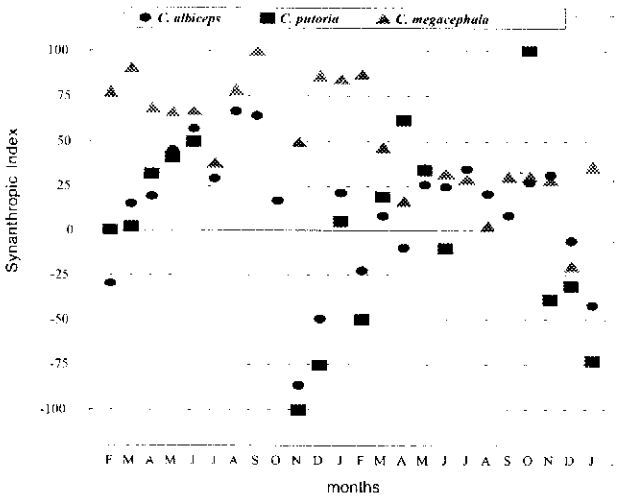


Fig. 3 - Monhtly variation of the synanthrópic index for *Chrysomya* species, from February/93 to January/95, in Pelotas, RS.

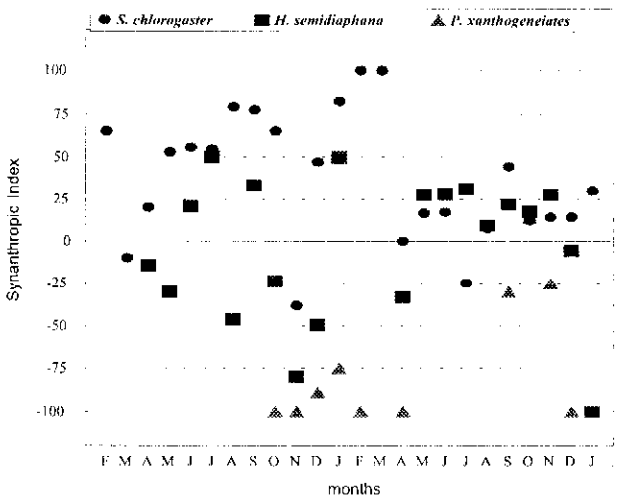


Fig. 6 - Monhtly variation of the synanthrópic index for *Sarconesia chlorogaster*, *Hemilucilia semidiaphana* and *Paralucilia xanthogeneiates* species, from February/93 to January/95, in Pelotas, RS.

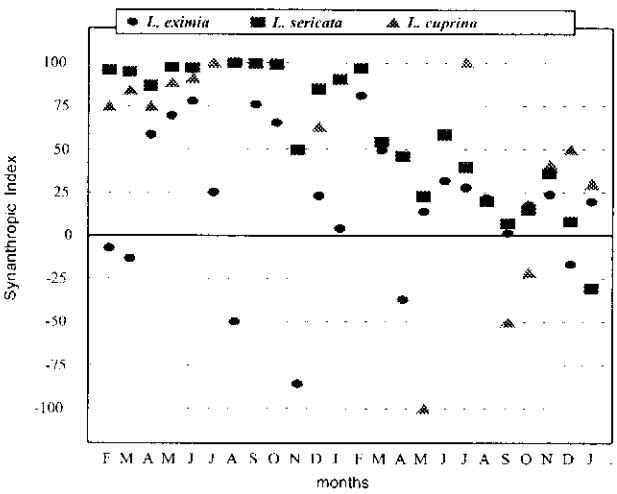


Fig. 4 - Monhtly variation of the synanthrópic index for *Lucilia* species, from February/93 to January/95, in Pelotas, RS.

alternate throughout the two year period (Figure 4) from -85.75 to +80.80, from +30.55 to +100 and from -100 to +100, for the three species, respectively.

*C. lopesi* and *C. vicina* presented S.I. values of +13,65 and +49,45 respectively. Their variations are presented in the Figure 5, and include positive as well as negative values. *C. lopesi* ranged from -84.49 to +65.39 and *C. vicina* from -66.75 to +100.

*S. chlorogaster*, *H. semidiaphana* and *P. xanthogeneiates* presented S.I. values of + 24.20, + 17.30 and - 84.65 respectively (Figure 1). Their variations are presented in the Figure 6. *S. chlorogaster* S.I. values ranged from -38.27 to +100, *H. semidiaphana* from -100 to +50.0 and *P. xanthogeneiates* from -100 to +14.25.

## DISCUSSION

The present work demonstrated that the muscoid species studied are more frequent in the environments modified by man.

The synanthropic index varied differently throughout the trial, according with the species monthly frequencies in the areas of capture. Generally, species with synanthropic indexes close to -100 / +100 showed more frequent monthly variations, around the general index. Notwithstanding, for those species whose general synanthropic index was far from the extreme values (-100 / +100), the monthly variation of the synanthropic index was remarkable. Such findings led us to conclude that variations in the synanthropic indexes are a common phenomena for calliphorids, and are related to the degree of the species dependence of a given environment. These facts were separatedly observed in some muscoid species by NUORTEVA (1963), in geographically distinct regions of Finland, by GREENBERG (1988) in *Chrysomya* species of South America, and also by FERREIRA (1983), who found a remarkable variation in the degree of synanthropy of *C. macellaria* for two cities: Goiânia and Curitiba. In the city of Goiânia a smaller variation was found in distinct collection periods.

*L. cuprina* showed the highest synanthropic index (eusynanthropic according to POVOLNY, 1971), the level of synanthropy found being similar to the results of LINHARES (1981) for the city of Campinas, São Paulo State, Brazil, where *L. cuprina* was also the more synanthropic species. Since *L. cuprina* use to rest upon human feces and is highly synanthropic, LINHARES (1981) considered it as having a potential importance for public health in the city of Campinas. For Pelotas, the epidemiological importance does not exists due to the low population found.

*C. megacephala* showed the second highest synanthropic index and abundance. Their S.I. was also similar to that found by LINHARES (1981). The monthly mean variation of the S.I. for this species during the two year trial always ranged between positive values, excluding only one month (December/ 94, S.I.=-19.95), what demonstrates the high dependence of this species on antropobiocenosis. GREENBERG (1973) & POVOLNY (1971) pointed the synanthropic and communicative traits of this species, and thus their major epidemiological importance. *C. megacephala* can be found on a huge diversity of ecological niches, as carcasses, human garbage, slaughter houses and cesspools (GUIMARÃES, 1984; GREENBERG 1971, 1973; and FURLANETTO *et alii*, 1984), and hence can act as vector for poliomyelitis virus, bacteria and other enteric pathogens. BOHART & GRESSIT (1951) considered *C. megacephala* as the muscoid of greatest public health importance in Guam, Philippines. PRADO & GUIMARÃES (1982) considered *C. megacephala* as being more potentially dangerous for public health than *Musca domestica*. LINHARES (1981) considered this species as the more prevalent in urban garbage. In the Pelotas city (BRUM, 1995, personal communication) *C. megacephala* has been observed on several different substrates as urban garbage, feces and carcasses, what altogether with their high populational density and synanthropic behavior, make this species the one of greater public health importance among all calliphorids studied.

*L. sericata* showed a eusynanthropic behavior, in agreement with the previously published results for other localities(NUORTEVA, 1963 - Finland, Czchec Republic and Sweden; FERREIRA, 1978 - Curitiba and FERREIRA, 1983 - Goiânia). Despite presenting a marked preference for inhabited areas, probably this species has not an important role as a disease vector due to its low populational density, what is in agreement with FERREIRA (1983) and LINHARES (1981). In Hungary, *L. sericata*, is a common finding in urban environments and is considered as an important vector for enteric disease (MIHÁLYI, 1965), and poliomyelitis (NUORTEVA, 1963).

Up to now, the synanthropic behavior of *C. vicina* was not know in Brazil, probably due their low occurrence. The synanthropic index in Pelotas for this species was +49.45, ranging from +100 to -66.75. NUORTEVA (1963) found variation in the synanthropic behavior of *C. vicina* in different geographical areas.

*S. chlorogaster* showed a synanthropic index of +24,20, being then assorted as a hemisynanthropic species, according to POVOLNY, 1971. Analyzing the monthly variation of the S.I. it is possible to conclude that, although there was no statistical significance(a=0,05) between the three capture areas, a larger occurrence was observed for the antropobiocenosis. Again based on POVOLNY (1971), we can assort this species as hemisynanthropic , in evolution to a eusynanthropic exophilic form.

*L. eximia* is another hemisynanthropic species, showing a S.I. of +18.85, with a marked monthly variation in their degree of synanthropy throughout the trial, ranging from +80.80 to - 85.75. FERREIRA (1983) also found such a variation and explained it as a dislocation of this species by the presence of *C. putoria*. In Pelotas, *L. eximia* appears not to have a major role in epidemiological concerns.

*H. semidiaphana* was less frequent and hemisynanthropic, what disagrees with LINHARES (1981) and FERREIRA (1983). Both authors classified *H. semidiaphana* as an asynanthropic species.

*C. lopesi* do not depends on inhabited areas, and showed a huge variation in their S.I., well demonstrating in this way its hemisynanthropic condition.

*C. albiceps* was the more prevalent species in Pelotas,

occurring in the three ecological areas, as well as in Campinas (LINHARES, 1981), being then an hemisynanthropic species. FERREIRA (1978, 1983) did not found *C. albiceps* both in Paraná and Goiás states. It is likely that this species was not established in these states by that time. Although *C. albiceps* is not dependent on inhabited areas, it occurs in such environments whenever a feed source for their larvae could be found. So, this species can be considered as having some epidemiological importance, besides being responsible by secondary myiasis, mainly in animals.

*C. macellaria* was independent of inhabited areas, being thus a hemisynanthropic species, what agrees with the work done in Cuba by GREGOR (1975). LINHARES (1981) and FERREIRA (1983) considered this species as eusynanthopic. FERREIRA (1978) working in Curitiba, classified *C. macellaria* as asynanthropic. These variation in the synanthropic behavior of this species at these different places, clearly demonstrates that geographically distinct strains can have synanthropic behaviors well differentiated.

*C. putoria* showed independence of inhabited areas, again in agreement with LINHARES (1981). Conversely, for FERREIRA (1983) this species demonstrated high preference for inhabited areas, being the more synanthropic species of the place, what confirms different behaviors for different areas.

*C. hominivorax* is a diptera that causes primary myiasis, and is assorted in a distinct group of synanthropic muscoids by POVOLNY (1971), but in this study we were concerned about the synanthropic aspects. This species showed a S.I. of -28.55 and an oscillation between the three ecological areas, demonstrated by the monthly variation of S.I. from +50.00 to -100, but a predominance around the general index occurred. Despite the low representativiness if compared to *C. macellaria* and *Chrysomya* species, *C. hominivorax* occurs in high numbers, and constitutes a serious animal health problem, causing large economical prejudices (OLIVEIRA, 1980).

*P. xanthogeneiates* was the only species that showed a preference for deserted areas, thus considered asynanthropic, and demonstrated a great dependence form the uncultivated area (S.I. = -84.85), what is in agreement with data from LINHARES (1981) and FERREIRA (1983).

According to the results and the methodology used in the present study, it is possible to conclude that thirteen calliphorid species occurred in Pelotas. The more frequent were *C. albiceps* and *C. megacephala*, respectively. Excluding only *P. xanthogeneiates*, all other calliphorids are associated to human environments in different degrees. The intensity of S.I. variation for a given calliphorid species is inversely proportional to the degree of their dependence from the ecological area with which this species is associated. Considering the populational intensity and the synanthropic index, *C. megacephala* is the calliphorid with greater epidemiological importance in Pelotas.

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## SUMÁRIO

Com o objetivo de identificar as espécies de Calliphoridae que ocorrem em Pelotas, bem como estimar o índice sinantrópico das mesmas, foram instaladas seis armadilhas W.O.T. (Wind Oriented Trap), em três áreas ecológicas distintas, urbana, rural e silvestre, duas por local, uma iscada com fígado bovino em decomposição e a outra com víscera de galinha em decomposição, no período de fevereiro/93 a janeiro/95. Foram capturadas 13 espécies de califorídeos, as quais foram agrupadas em três categorias distintas, de acordo com as diferenças significativas das médias das frequências entre as três áreas ecológicas, ou seja, espécies com preferência por áreas habitadas: *Lucilia cuprina*, *Chrysomya megacephala*, *Lucilia sericata* e *Calliphora vicina*, espécies com independência por áreas habitadas: *Sarconesia chlorogaster*, *Lucilia eximia*, *Hemilucilia semidiaphana*, *Calliphora lopesi*, *Chrysomya albiceps*, *Cochliomyia macellaria*, *Chrysomya putoria* e *Cochliomyia hominivorax*, e uma única espécie, *Paralucilia xanthogeneiates*, com preferência por áreas desabitadas. A maioria das espécies tem preferência pela antropobiocenose e agrobiocenose, sendo *L. cuprina* a com maior grau de sinantropia (+79,10) e *P. xanthogeneiates* a única espécie assinantrópica (-84,65), considerando-se ainda que entre as espécies eussinantrópicas, *C. megacephala* é a de maior densidade populacional.

PALAVRAS-CHAVE: Calliphoridae, Diptera, sinantropia.

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