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SYNANTHROPY OF SARCOPHAGINAE (DIPTERA) FROM CUBA

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Dedicated to Academician Bohumír Rosický on the occasion of his 50th birthday.

Abstract. The material of synanthropic flies collected by light-trap methods in Cuba in 1966 was quantitatively and qualitatively analyzed. Relative density, seasonal incidence and food preference were ascertained in 23 species of Sarcophaginae. In conclusion 18 species of Sarcophaginae were characterized as potential vectors of some diseases of man.

This paper is the first of a planned series on the degree and mode of synanthropy of medically important flies of Cuba. In order to identify the most important species and their role as possible vectors of some human diseases, the material consisting of 35,500 individuals (183 samples) was arranged into taxonomical groups. To our knowledge, nothing has been published as yet on the synanthropy of neotropical Sarcophaginae.

MATERIAL AND METHODS

The flies were collected from March 4 till September 16, 1966, mostly in the area of the Biological Institute of the Cuban Academy of Sciences in Havana, but also in the vicinity of Havana and in various provinces of Cuba except the province Camagüey.

In addition to standard trapping methods, an occasional fly was baited on attractive substrates. The two types of traps used were a) a transportable (folding) trap consisting of a wire skeleton covered with nylon (see Gregor and Povolný 1960); b) a normalized fly trap consisting of plexiglass. Originally, this type of trap had been recommended by the Cuban Ministry of Agriculture for the control of house-flies. Both types of traps were of equal effectivity. The bait substrate consisted of human faeces and meat of both invertebrates (molluscs) and vertebrates (fishes, intestines of mammals and birds), cow dung and faeces, and fruit.

A total of 3,819 Sarcophaginae were sorted according to the morphology of the postabdomen and that of other parts of the body. Several species were identified by the author himself, the majority, however, were determined by Professor B. B. Rohdendorf (Moscow), who has published a paper on systematic and faunistic studies of this material (Rohdendorf 1971). Other material of Sarcophaginae from Cuba has been evaluated by Gregor and Rohdendorf (in press). Females of the genus *Sarcophagula* Wulp formed a large portion of our material, but their identification is, as yet, impossible. There were, practically, only the species *S. occidua* (Fabr.) and *S. canuta* Wulp and we could estimate their population density only by comparing their numbers with that of the males. A large portion of the material (97 %) was preserved in alcohol, the rest was pinned. Since the number of samples in our material was too high, it was impossible to review all individuals collected in a single table and, therefore, we present the final evaluation of the material in diagrams. Since also

the time of exposure was not uniform, we used as the basic unit the average number of flies trapped within one hour.

The habitat: In order to detect synecological and chorological relationships among the individual species, which may facilitate the classification of synanthropy and its degree, we selected samples from habitats of a similar character by observing the following criteria: a) character and intensity of anthropurgic influence in the habitat; b) character of the habitat with special reference to its configuration and microclimate; c) character of vegetation of the habitat. As illustrated in Fig. 1 it was possible to distinguish these categories of the habitats:

1. Tropical lowland rain forest. Selected exploitation of wood, occasional presence of man; no cattle.

2. Tropical semideciduous forest on hill slopes (up to 500 m above sea level). Selected exploitation of wood, occasional presence of man; no cattle.

3. Partially deforested habitat for grazing. Degraded phytocenosis of the same type as category (2). Extensive grazing, occasional presence of man.

4. Bush, neglected pasture-land frequently visited by man and cattle.

5. Coastal bush on rocky and stony slopes. Characteristic plants: *Lantana*, *Erythroxylon* spp. No grazing, occasional presence of man.

6. Seashore, rocky and sandy area between the sea and *Coccolobetum*. No grazing, occasional presence of man.

7. Pasture land with intensive grazing, an occasional palm *(Roystonia regia)* and small groups of shrubs. Permanent presence of cattle and man.

8. *Pinetum* — thin growth of *Pinus tropicalis* of the savanna type on skeletal soil (laterite). No grazing, the presence of man occasional.

9. Residential district in Havana — the grounds of the Department of Parasitology, Biological Institute of the Cuban Academy of Sciences, Havana-Marianao. A site with several pavilions and various outhouses, partly arranged as a park with exotic trees and ornamental shrubs, partly grassland with an occasional *Roystonia*, *Mangifera* etc., and with cots to house the experimental animals (mammals and fowl).

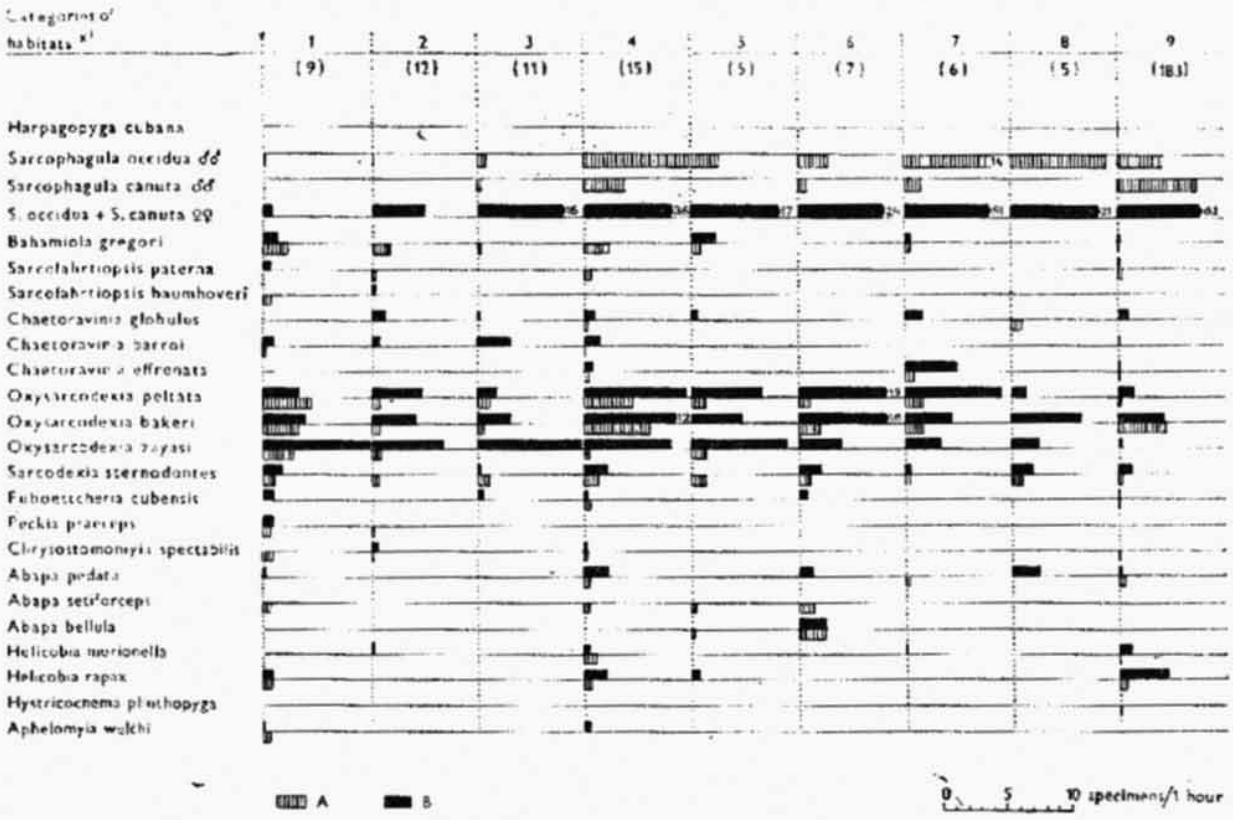

Fig. 1. The composition of the Sarcophaginae fauna in the various habitats.*) See p. 156. Numbers in parentheses indicate the number of samples. A — males, B — females.

RESULTS

A. RELATIVE DENSITY AND FREQUENCY OF SARCOPHAGINAE IN THE VARIOUS HABITATS

As shown in Fig. 1, most of the species are eurytopic. Among them there are several species of a constant and uniform density (*Oxysarcodexia bakeri* (Aldrich), *Sarcodexia sternodontes* Townsend, *Chaetoravinia globulus* (Aldrich)); other species show a predilection for certain habitats. Among these are: a) species infrequent in forest habitats (*Sarcophagula canuta* Wulp, *S. occidua* (Farb.)); b) species preferring forest habitats (*Chaetoravinia barroi* Dodge, *Peckia praeceps* Wiedemann); c) species infrequent in urban habitats (*Oxysarcodexia zayasi* Dodge and, to a certain degree, *Oxysarcodexia peltata* (Aldrich)). There may also have been other species represented in these habitats, but these were not abundant enough in our samples; d) a group of purely stenotopic species typical of coastal habitats (*Abapa bellula* Dodge and, very likely, *Sarothromyia femoralis* (Schiner)). Two members of the genus *Helicobia* Coquillett, *H. rapax* and *H. morionella*, could not be included under a) to d), because they showed considerable variation in both the sites of occurrence and incidence in the individual months. There is, however, a striking and apparently not incidental density of *Helicobia rapax* (Walker) in suburban habitats in comparison with rural habitats and cubiocenoses.

B. THE SPECTRUM OF SPECIES IN THE INDIVIDUAL HABITATS

Contrary to our expectations we found no major differences. The basic character of all these habitats is determined by the density of species of the genus *Sarcophagula*

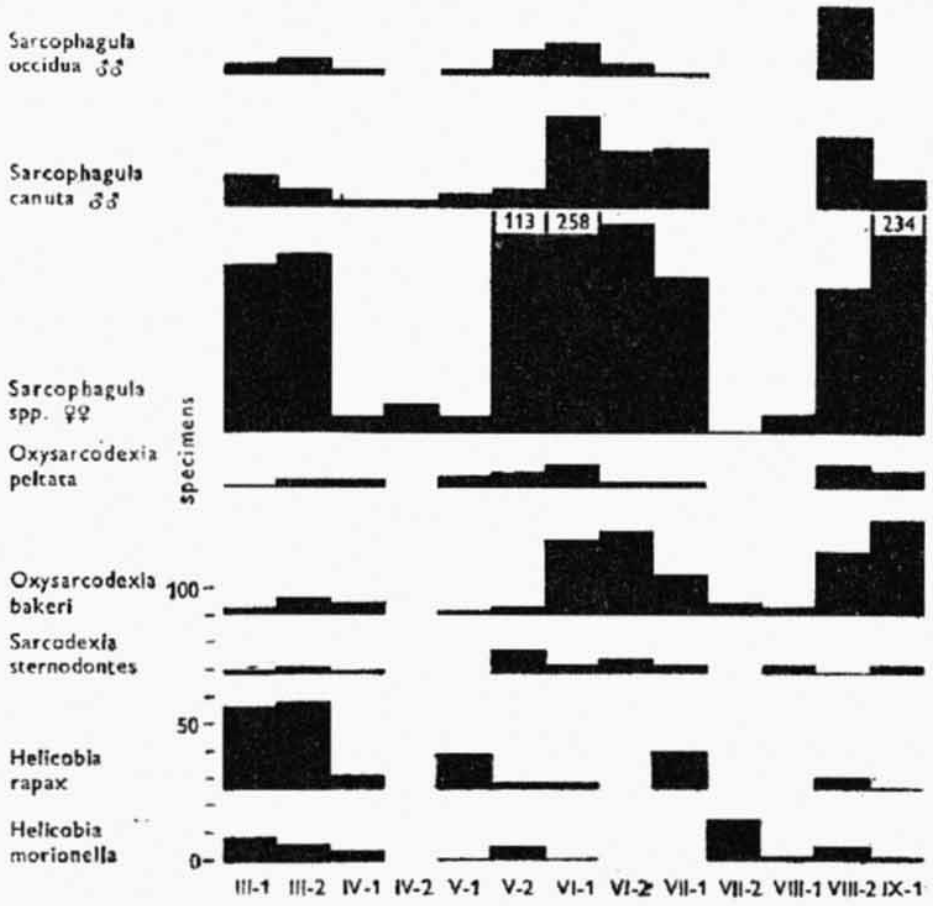

Fig. 2. The abundance of the most important synanthropic species of Sarcophaginae from March to September 1966 (Havana).

Wulp (2 species) and *Oxysarcodexia* Townsend (3 species). Forest habitats (1), (2) and (3) are characterized by the high density of *Oxysarcodexia zayasi* Dodge and the low density of *Sarcophagula* spp.; this is reversed only in the typical suburban habitat (9). Category (1) comprizes samples from forest eubiocenoses, in which the influence of man was found to be lowest in comparison with the other habitats. This is in logical accord with the considerably high number of species represented (17 out of 23 species) and with the almost uniform relative density. An exception is *O. zayasi* which is dominant in forest habitats; this, however, may be specific of this pecies. By contrast, category (9) is typical of an anthropobiocenosis with characteristic density contrasts among the dominants (*S. canuta* and *S. occidua*), subdominants (*O. bakeri* and *H. rapax*) and other species.

C. SEASONAL INCIDENCE

The seasonal changes of incidence of the seven most important species collected in 14 day-intorvals is shown in Fig. 2. The diagram covers only part of the year, starting with the end of the winter season (dry period) and comprizing a major portion of the rainy period (from the end of May). The difference in daily average temperature (from March till June) did not surpass 5—7 °C and neither was there a marked difference in the amount of precipitation during this period, because rain-

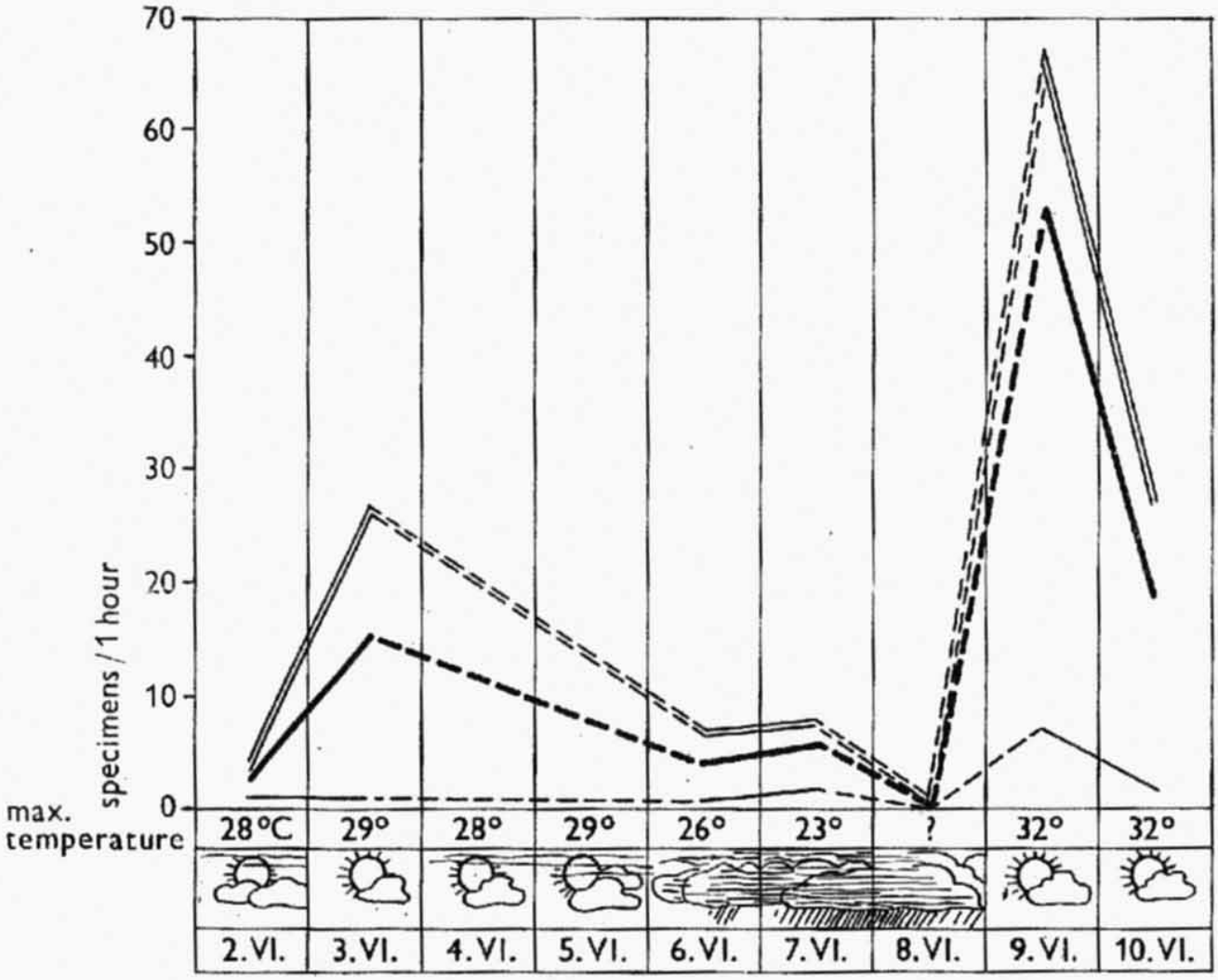

Fig. 3. Changes in activity of adult flies (Sarcophaginae) during the 9 day-long cyclone "Alma" in Cuba, June 1966. = Total of Sarcophaginae, ▬ *Sarcophagula* spp., females, — *Sarcophagula canuta*, males.

fall had been abnormally heavy in the winter of 1966. According to meteorological records, the average amount of precipitation in Havana is 70 mm in March, 160 mm in June. The final paper of this series will analyze all these facts in detail when dealing with the complex of all important synanthropic flies.

The diagram shows a marked periodicity in density changes in all seven species. Five of the species show three distinct maxima, while four indistinct maxima were observed in *H. rapax* and, to some degree, also in *H. morionella*. Remarkable is the fact that all species attained their first maximum in March, the second in June and, except the members of the genus *Helicobia*, all others attained their third maximum at the end of August and the beginning of September. There is, thus, a three month-periodicity. With the exception of species of the genus *Helicobia*, all other species, i.e., *S. occidua*, *S. canuta*, *O. peltata*, *O. bakeri* and *S. sternodontes* increase their population density between the first and second maximum. The observed three month-periodicity is remarkable and it is, therefore, highly regrettable that no data were available on the preceding winter period. Detailed studies of the autecology of the individual species may possibly offer a solution to this problem. Although this problem of autecology has not been treated specifically, it may be interesting to mention some changes in the incidence of Sarcophaginae observed during the passage of the cyclone "Alma" over Cuba in June 1966 (Fig. 3). The course of the curves is hypothetical as regards June 4, 5 and 8, because flies had not been collected in these days. Complete inactivity of the flies had been observed from 18·00 hrs. of June till 10·00 hrs. of June 8. The vehement activity of Sarcophaginae as soon as the cyclone had expired is illustrated in the diagram. Fly activity on June 9 surpassed any observed average and even the maximum values recorded in June. Neither did heavy rainfall and the hurricane cause losses to Sarcophaginae populations as demonstrated by the general density after the cyclone and especially

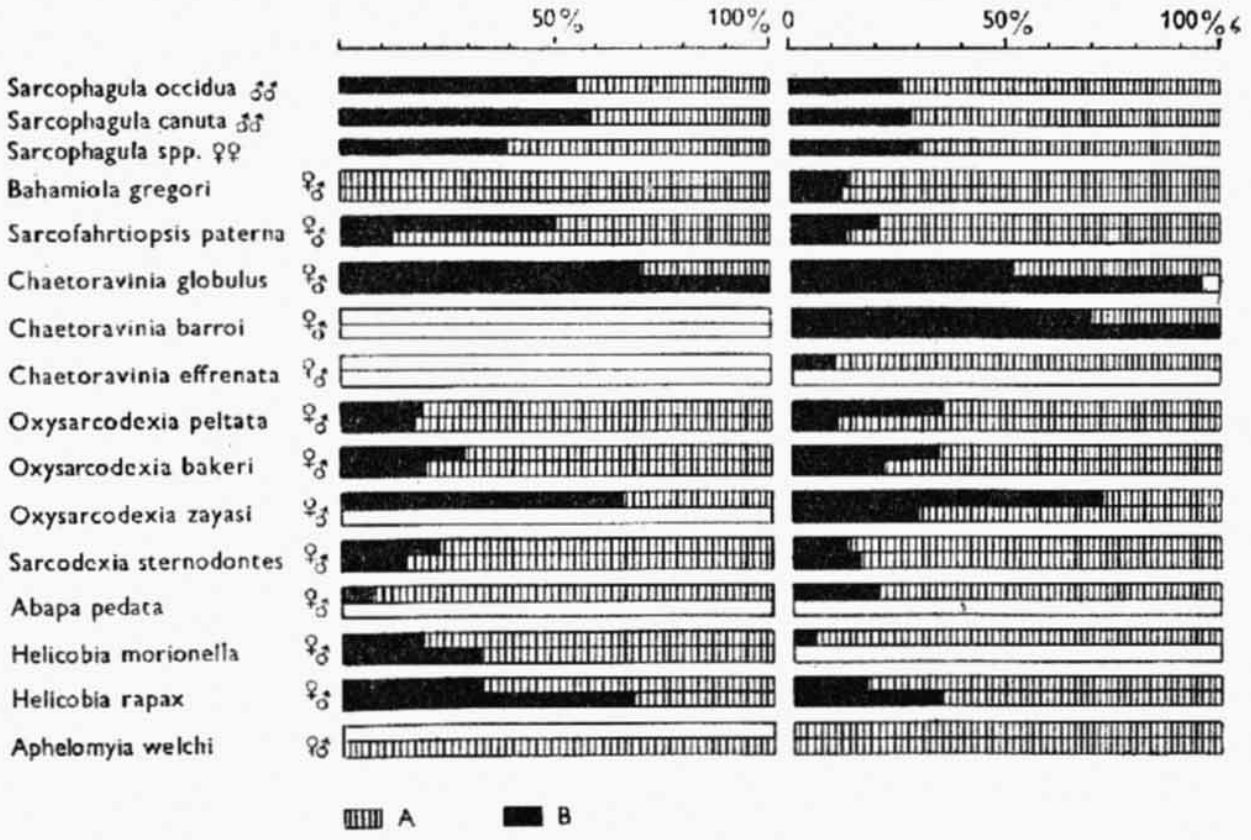

Fig. 4. Relative abundance of Sarcophaginae on meat (A) and human faeces (B), left Havana, right diverse localities in Cuba (see text).

by the incidence of the species *Sarcophagula canuta* (viz. also Fig. 2). This fact should be considered to be of epidemiological importance.

D. CHOICE OF FOOD OF THE ADULT FLY

Fig. 4 compares the average number of individuals baited on decaying meat and human faeces. A considerable lack of preference was observed in all but two species, *Aphelomyia welchi* (Hall) (preference to meat) and *Bahamiola gregori* Rohdendorf (preference to meat in samples from Havana only). The majority of species showed variation in their preference to decaying meat; on the other hand, *C. barroi* and *C. globulus* as well as the females of *O. zayasi* preferred human faeces. There was also variation in the choice of food among the sexes. While more than 50 % of females of the species *C. barroi* and *C. globulus* preferred faeces to meat, all the males fed on faeces only. Meat was preferred also by the males of the genus *Helicobia* Coquillett. The females of the three species of *Oxysarcodexia* fed more frequently on faeces than did the males.

Table 1. The attraction of different types of bait to different Sarcophaginae species

	Meat	Cheese	Human faeces	Cow dung	Fruit (mango)
Sarcophagula spp. ♀♀	61	8	29	1	
Sarcophagula occidua ♂♂	4	1	2		21
Sarcophagula canuta ♂♂		3	2		21
Chaetoravinia globulus	1	3			
Oxysarcodexia peltata	5	1			
Oxysarcodexia bakeri	21	2	2		3
Oxysarcodexia zayasi		6			
Sarcodexia sternodontes	4	1	1		
Helicobia rapax		11	5		14
Helicobia morionella	1	2	2		
Total	97	38	43	1	53
Number of species	7	10	7	1	4

Table 1 gives the results of four hours of baiting on five different substrates, performed in the garden of the Biological Institute in Havana from 9·00 hrs to 13·00 hrs. on April 5, 1966. It was partly cloudy with a maximum temperature of 30 °C. The traps were placed at 10 and 20 m from one another. The purpose of this trapping was tentative and performed in order to establish, whether and which of the species are capable of transmitting human pathogens from the faeces to other substrates or to human food. According to the table, cheese was the universal attractant. Less attractive were meat and faeces, although the percentage of flies feeding on meat amounted to 97; in these high numbers participated mainly the females of *O. bakeri* and *Sarcophagula* spp. The attraction of fruit was relatively poor except for the males of *S. canuta* and *H. rapax*. Cow dung was the least attractive as observed also in samples from other localities and habitats, where only a total of 10 Sarcophaginae flies could be baited on it (2 ♂ of *Harpagopyga cubana* Lopes, 2 ♀ of *Sarcophagula* sp., 1 ♀ of *Chaetoravinia globulus* and 1 ♂ of *Helicobia rapax*).

CONCLUSIONS

On the basis of the discussed questions, an attempt has been made to estimate the role and importance of the individual fly species as possible vectors of human diseases. For this purpose, characteristics are given of these species of Sarcophaginae, which were present in our samples with a certain regularity. Some of the specific terms had been suggested in an earlier paper by Gregor and Povolný (1958) (see also Greenberg et al. 1971).

1. *Sarcophagula occidua* (Fabr.). Communicative hemisynanthrope, slightly preferring meat to human faeces. The species appears to be rather eurytopic, avoiding shady tropical forests, but abundant in extensive pastures (degraded forests, bush) or in thin pine forests.

2. *Sarcophagula cuneata* Wulp. Communicative hemisynanthrope, slightly preferring meat to human faeces, but frequent on fruit. It avoids shady tropical forests and thin pine forests, generally being abundant in suburban districts (Havana).

3. *Bahamiola gregori* Rohdendorf. Very likely a less communicative hemisynanthrope, obligatory feeding on meat only. No striking abundance. The species is probably a cadavericolous member of the original element of neotropical forests (possibly endemic).

4. *Chaetoravinia globulus* (Aldrich). A less communicative hemisynanthrope, preferring human faeces to meat, frequent on cheese. The species is rather eurytopic, not very frequent or dominant.

5. *Chaetoravinia barroi* Dodge. Same as former, prefers faeces to meat. Likely an original member of the biocenoses of the tropical forest, where it is of medium abundance, being absent in strongly deforested habitats.

6. *Chaetoravinia effrenata* (Walker). Due to its rare occurrence the species is difficult to characterize. It prefers meat to human faeces.

7. *Oxysarcodexia peltata* (Aldrich). Communicative hemisynanthrope, slightly preferring meat to human faeces. In the eubiocenoses of forests the species may be extremely frequent and abundant, in anthropobiocenoses mostly less abundant.

8. *Oxysarcodexia bakeri* (Aldrich). Strictly communicative hemisynanthrope, slightly preferring meat to human faeces, rather eurytopic (ubiquitary), very frequent, abundant (perhaps with the exception of the winter season).

9. *Oxysarcodexia zayasi* Dodge. Communicative hemisynanthrope. Females slightly preferring human faeces to meat (this may be opposite in the males), but numerous on chese. The species is endemic in shady neotropical forests, where it often may be abundant. It is less frequent in the suburbs. Females dominating over the males in abundance.

10. *Sarcodexia sternodontes* Townsend. Communicative hemisynanthrope, visibly preferring meat to human faeces, rather common, but never abundant. Sex ratio generally at the same level.

11. *Euboettcheria cubensis* (Dodge). Hemisynanthrope, less frequent and abundant, difficult to characterize.

12. *Chrysostomomyia spectabilis* (Aldrich). Hemisynanthrope, same as the preceding species, probably confined to forest eubiocenoses.

13. *Abapa pedata* (Aldrich). Hemisynanthrope, less frequent, sometimes numerous, visibly preferring meat to human faeces. Endemic.

14. *Abapa bellula* Dodge. Hemisynanthrope, stenotopic, specific of the seashore and islets, where it may develop considerable density, sex ratio equivalent. Preferring meat, fishes and molluscs.

15. *Helicobia morionella* (Aldrich). Communicative hemisynanthrope, especially females preferring meat to human faeces, very volatile, generally not abundant in incidence. The species does not appear to be a member of the original Cuban forest eubiocenoses.

16. *Helicobia rapax* (Walker). Communicative hemisynanthrope, females preferring meat to human faeces, males feeding mostly on fruit. In the suburbs of Havana, the species belonged to most common Sarcophaginae at the end of dry season (March, April), being, however, frequently absent in the spring and summer season and in agro- and eubiocenoses.

17. *Hystricocnema plinthopyga* (Wiedemann). It may be of interest that this well-known synanthropic fly occurring in Central America and in the North of South America is most infrequent in Cuba; this may be due to the climate which may be unsuitable for this species. Only two males could be detected in our material. Myiasis producing species (James 1947).

18. *Aphelomyia welchi* (Hall). Unimportant hemisynanthrope, captured mostly on meat.

It has been practically impossible to determine the "danger-index" (sensu Mihályi 1967), in view of a scarcity of important data on the ecology of the species under consideration. Neither could a similar index employed by Nuorteva (1963) be used in view of the few samples obtained from the city of Havana, because we trapped them in the suburbs of Havana only. It is questionable whether it is possible to apply the synanthropic index by Nuorteva under tropical conditions, because several important limiting abiotic factors, such as "pessimal" temperature of northern latitudes are not available. We will deal in general with these problems in the concluding paper on Cuban synanthropical Diptera.

An approximate picture of affinities of the individual species to human settlements may be offered by a comparison of the frequency and abundance in Sarcophaginae in the locality of Havana and in habitats not or little affected by anthropurgic factors. In two species only, i.e. in *Sarcophagula canuta* and *Helicobia rapax*, the incidence was higher in suburban environments than in an eubiocenosis. Theoretically these two species only may show a positive index of synanthropy. However, all species of Sarcophaginae, considered in this paper, are merely hemisynanthropic, most of them being more abundant in nature than in or near human settlements. No synbovine flies are present among the Sarcophaginae in Cuba. These facts are not very surprising, when considering the fact that practically none of the species of the Sarcophaginae developed as yet a high degree of synanthropy (sensu Nuorteva 1963). The majority of Cuban synanthropic Sarcophaginae are members of Cuban eubiocenoses of which 3—4 species are endemic.

It is possible that some important synanthropic Sarcophaginae may be introduced to Cuba in the future, or had been introduced, but could not develop as yet dense enough populations and therefore are found only occasionally, such as *Hystricocnema plinthopyga* (Wied.).

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СИНАНТРОПИЯ У МУХ ПОДСЕМЕЙСТВА *SARCOPHAGINAE* (*DIPTERA*) НА КУБЕ

Ф. Грегор

Резюме. Материал синантропных мух, добытый на Кубе в 1966 г., был проанализирован с квантитативной и квалитативной точек зрения. У 23 видов мух подсемейства *Sarcophaginae* установлено их относительное изобилие в разных типах биотопов, сезонные изменения численности и предпочитаемая пища. В заключение дана характеристика 18 видов мух *Sarcophaginae*, которые можно считать потенциальными переносчиками некоторых заболеваний у человека.

REFERENCES

GREENBERG G. et al., Flies and diseases. Vol. I., Ecology, Classification and Biotic Associations. Princeton University Press, Princeton, New Jersey, 856 pp., 1971.

GREGOR, F., POVOLNÝ D., Versuch einer Klassifikation der synanthropen Fliegen. J. Hyg. Epidem. 2: 205—216, 1958.

—, ROHDENDORF B. B., The identification of the Cuban Sarcophaginae (Diptera). (In press).

JAMES M. T., The flies that cause myiasis in man. United States Government Printing Office, Washington, 175 pp., 1947.

LOPES H. S., Family Sarcophagidae, in: A Catalogue of the Diptera of the Americas South of the United States, Dept. Zool., Secr. Agric., São Paulo, part 103, 87 pp., 1969.

MIHÁLYI F., The danger-index of the synanthropic flies. Acta Zool. Hung., 13: 373—377, 1967.

NUORTEVA P., Synanthropy of blowflies (Dipt., Calliphoridae) in Finland. Ann Ent. Fenn., 29: 1—49, 1963.

ROHDENDORF B. B., On the Sarcophaginae from Cuba (Diptera). Acta Mus. Moraviae Sci. Nat., 55: 89—114, 1971 (1970).

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