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SYNANTHROPY OF ANTHOMYIIDAE, MUSCIDAE AND CALLIPHORIDAE (DIPTERA) IN CUBA

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Abstract. The material of 22302 flies of Anthomyiidae, Muscidae and Calliphoridae collected by trap-method in Cuba 1966 was qualitatively and quantitatively analysed. Relative density, seasonal incidence and food preference were ascertained in 20 species. In potential vectors of human diseases the ecological characters and classification of synanthropy are given.

This paper is a continuation of previous papers by Rohdendorf (1971), Gregor (1972) and by Rohdendorf and Gregor (1973). It deals with imagines of those species of flies, which were baited during the year 1966 in Cuba on sanitary important substrates and, for this reason, they eventually could be important as potential vectors of Enterobacteriaceae or of other pathogenic agens. The aim of this paper is to ecologically characterize single species and to classify their synanthropy.

MATERIAL AND METHODS

The kind of baiting and sampling as well as other details are given in a previous paper (Gregor 1972). The material was determined partly by the author, partly, on the basis of selected specimens, determined and revised by D. M. Ackland (Anthomyiidae), A. C. Pont (Muscidae) and M. T. James (Calliphoridae). Several specimens of Muscidae remain undetermined, a new species of the genus *Ophyra* was recently described. In the whole, 183 samples were baited of the families concerned yielding 9637 specimens from Havana and 12 665 specimens from various Cuban provinces respectively, with the exception of the province Camagüey. For technical reasons, it is impossible to present this material, as a whole, in the form of a tabelar review. The author's material was supplemented by little samples collected by Dr. V. Černý (in 1965) and by J. de la Cruz (in 1966). I express my gratitude to all the mentioned individuals, who contributed to this paper.

RESULTS

LIST OF SPECIES

In species, which are generally distributed and common, no localities or data of collecting are given. In those species, which were represented by a few individuals only, and on which there are no comments in the text to follow, the bait, on which they were sampled, is given. The species not mentioned for Cuba in the Catalogue of the Diptera of the Americas south of the United States (Pont 1972, James 1970) are marked by asterisk.

Family Anthomyiidae

Calythea micropteryx Thomson, 1869.—Det. D. M. Ackland.
Prov. Pinar del Rio: Sierra de Cajalbana, 13 ♂, 67 ♀ 16. and 21. VI.; Soroa, 12 ♂, 88 ♀ 14. IV., 3 ♀ 4. VIII., 1 ♂, 1 ♀ 18. VIII.; San Diego de los Baños, 12 ♂ 188 ♀ 23. IV., 2 ♀ 3. VIII.; La Guira, 22 ♀ 3. III.; Guajaibon, 7 ♂, 65 ♀ 14. and 31. III., 5 ♂, 45 ♀ 3. V. — Prov. Habana: Habana-Marianao, 57 ♂, 921 ♀ III.—VII.; Santa Fé 2 ♀ 10. VI.; Playa Santa Maria, 1 ♀ 6. III.; Boca de Canasí, 1 ♂, 11 ♀ 2. IV.; Cuatro Caminos, 1 ♀ 14. III., 15 ♂, 70 ♀ 20. IV., 1 ♀ 18. VIII.—Prov. Matanzas: Jovellanos, 1 ♂ ,12 ♀ 26. III.; Varadero, 15 ♀ 11. IV.—Prov. Las Villas: Playa Larga, 4 ♀ 7. VIII.; Sierra de Trinidad, 4 ♀ 30. VI.—Prov. Oriente: Bueycito, 10 ♀ 14. VII.; Guisa, 1 ♀ 15. VII.; Bayamo, 6 ♀ 13. VII.; La Gran Piedra, 1150 m a. s. l., 2 ♀ 17. VII.

Family Muscidae

Fannia pusio (Wiedemann, 1830)—Det. A. C. Pont.
Prov. Pinar del Rio: Viñales, 1 ♂, 11 ♀ 22. VI.; Soroa, 1 ♂, 6 ♀ 4. VIII.; San Diego de los Baños, 41 ♀ 23. IV., 4 ♂, 4 ♀ 3. VIII.; Guajaibon, 1 ♀ 3. V., 1 ♂, 7 ♀ 25. V.— Prov. Habana: Habana—Marianao, 15 ♂, 136 ♀ III.—IX.; Cuatro Caminos, 3 ♂, 24 ♀ 20. IV., 1 ♂, 1 ♀ 20. V.; Catalina, 3 ♂, 1 ♀ 14. VI.—Prov. Matanzas: Arroyo Bermejo, 2 ♀ 29. VII. — Prov. Oriente: Barrancas, 1 ♂, 11 ♀ 12. VII.; Bayamo, 1 ♂, 1 ♀ 13. VII.; Bueycito, 15 ♂, 18 ♀ 14. VII.; La Gran Piedra, 1150 m a. s. l., 4 ♀ 17. VIII. Prov. Las. Villas: Playa Larga, 8 ♂, 22 ♀ 7. VIII.; Trinidad, 7 ♀ 29. VI.; Sierra de Trinidad, 530 m a. s. l., 1 ♀ 3. VI.
Fannia sp. I, *benjamini*-group. — Det. A. C. Pont.
Prov. Pinar del Rio: Viñales, 2 ♂, 5 ♀ 22. IV. 66; Soroa, 1 ♀ 14. IV., 1 ♀ 4. VIII., 1 ♀ 28. VIII.; Guajaibon, 1♂, 2 ♀ 14., 1 ♀ 31. III., 1♂, 8 ♀ 25.V.; La Guira, 1 ♀ 3. III.,—Prov. Habana: Habana—Marianao, III., V., VI.; Cuatro Caminos, 2 ♀ 21. III., 1 ♀ 20. IV.; Catalina, 9 ♀ 14. VI.—Prov. Las Villas: Trinidad, 8 ♀ 29. VI.—Prov. Oriente: Bueycito, 7 ♀ 14. VII.; La Gran Piedra, 1150 m, 1 ♀ 17. VII.; Guisa, 2 ♀ 15. VI .
Fannia sp. II, *scalaris*-group. Det. A. C. Pont.
Prov. Oriente: La Gran Piedra, 1150 m, 1 ♀ 17. VII.
Musca domestica, Linnaeus, 1758.
This species was observed everywhere in human dwellings. In free nature, on baits placed at minimum distance of 200 m from human dwellings it was found on the following localities: Prov. Pinar del Rio: Guajaibon, 1 ♂ ,12 ♀ 25. V.—Prov. Habana: Habana—Santa Fé, 2 ♂, 13 ♀ 10. VI.; Cuatro Caminos, 2 ♀ 20. V. Prov. Las Villas: Sierra de Trinidad, 520 m a. s. l., 1 ♂, 1 ♀ 30. VI.
Morellia basalis (Walker, 1852).—Det. A. C. Pont.
Prov. Pinar del Rio: Sierra de Cajalbana (La Mulata) 11 ♂, 54 ♀ 16.—21. VI.; Soroa, 14 ♂, 48 ♀ 14. IV., 11 ♂, 22 ♀ 4. VIII.; La Guira, 3 ♀ 3. III.; San Diego de los Baños, 74 ♂, 198 ♀ 23. IV.; Guajaibon, 6 ♀ 14. III., 2 ♂, 2 ♀ 3. V., 1 ♀ 4. IX.—Prov. Habana: Habana—Marianao, 93 ♂, 137 ♀ III.—IX. Cuatro Caminos, 5 ♂, 17 ♀ 20. IV., 8 ♂, 6 ♀ 18. VIII.—Prov. Matanzas: Arroyo Bermejo, 2 ♂, 4 ♀ 29. VII. Prov. Las Villas: Sierra de Trinidad, 530 m, 12 ♂, 28 ♀ 30. VI. — Prov. Oriente: Bueycito, 1 ♂, 7 ♀ 14. VII.; Guisa, 15. VII.
Morellia ?semimarginata (Stein, 1918).—Det. A. C. Pont.
Prov. Pinar del Rio: Sierra de Cajalbana (La Mulata), 6 ♂, 54 ♀ 16. VI.; Soroa, 5 ♂, 60 ♀ 14. IV., 127 ♂, 357 ♀ 4. VIII.; San Diego de los Baños, 90 ♂, 168 ♀ 23. IV.—Prov. Habana: Cuatro Caminos, 1 ♂ 18. VIII.—Prov. Las Villas: Sierra de Trinidad, 520 m, 8 ♂, 3 ♀ 30. VI.— Prov. Oriente: Bueycito, 5 ♀ 14. VII.; La Gran Piedra, 1200 m, 23 ♀ 17. VII.
**Synthesiomyia nudiseta* (Wulp, 1883).
Prov. Pinar del Rio: San Diego de los Baños, 1 ♂, 2 ♀ 23. IV., 2 ♀ 3. VIII.; Soroa, 18 ♀ 4. VIII.; Guajaibon, 2 ♂, 2 ♀ 25. V. Prov. Habana: Habana—Marianao, 58 ♂, 233 ♀ III.—IX.; Playa Santa Maria, 1 ♀ 6. III.; Cuatro Caminos, 1 ♀ 20. V.; Catalina, 2 ♀ 14. VI.; Jaruco, 2 ♀ 15. IX. — Prov. Las Villas: Playa Larga, El Maíz. 1♀ 10. VIII.; Trinidad, 6 ♀ 29. VI.— Prov. Oriente: Barrancas, 1 ♀ 12. VII.
**Ophyra aenescens* (Wiedemann, 1830).
Isla de Pinos: Rancho El Tesoro, 15. IV., 20. IV. 1965, leg. V. Černý.—Prov. Pinar del Rio: Viñales, 22., 23. VI.; Sierra de Cajalbana (La Mulata), 16. VI.; Soroa, 4. VIII.; San Diego de los Baños, 23. IV., 3. VIII.; Guajaibon, 25. V.—Prov. Habana: Habana—Marianao, III.—IX.; Catalina, 14. VI.; Cuatro Caminos, 20. V.—Prov. Las Villas: Playa Larga, 10. VIII.; Trinidad, 29. VI.; Sierra de Trinidad, 530 m, 30. VI.—Prov. Oriente: Barrancas, 12. VII.; Bueycito, 14. VII.
**Ophyra cubana* Gregor, 1974.
Prov. Pinar del Rio: Viñales, 1 ♂, 26 ♀ 22. VI.; Soroa, 1 ♂, 2 ♀ 4. VIII.; Valley 7 km N San Diego de los Baños, 16 ♂, 44 ♀ 23. IV., 2 ♂, 5 ♀ 3. VIII. Prov. Las Villas: Trinidad, 1 ♀ 29. VI.; Sierra de Trinidad, 530 m, 1 ♀ 30. VI.; Playa Larga, 2 ♀ 7. VIII.—Prov. Oriente: Bueycito, 2 ♂, 2 ♀ 14. VII.
**Gymnodia arcuata* (Stein, 1898). Baited in all lobalities studied.
**Gymnodia debilis* (Williston, 1896). — Det. A. C. Pont.

Prov. Habana: slaughter-house J. A. Mello, manure, 1 ♂ 10. III.; Habana—Marianao, 1 ♀ 9. III., 4 ♀ 14. III., 3 ♀ 16. III., 1 ♀ 29. III., 1 ♀ 7. VII.—Prov. Pinar del Rio: Soroa, 1 ♀ 4. VIII.—Prov. Las Villas: Playa Larga, 2 ♀ 7. VIII.; Sierra de Trinidad, 530 m, 1 ♀ 30. VI.—Prov. Oriente: Bueycito, 1 ♀ 14. VII.; Guisa, 4 ♂, 85 ♀ 15. VI.

Atherigona orientalis Schiner, 1868.– Rev. A. C. Pont.

Prov. Pinar del Rio: San Diego de los Baños, 3 ♀ 23. IV., 3 ♀ 5. VIII; Guajaibon, 4 ♀ 3. V., 80 ♀ 25. V., 1 ♀ 4. VIII.—Prov. Habana: Habana—Marianao, III.– IX. 125 ♀; Cuatro Caminos, 1 ♀ 21. III, 5 ♀ 20. V.; Catalina, 1 ♀ 14. VI.—Prov. Oriente: Barrancas, 7 ♀ 12. VII.; Bueycito, 3 ♀ 14. VII.

?*Mydaea* sp.– Det. A. C. Pont.

Habana– Marianao, 3 ♀ 11. III., (on faeces).

Myospila obsoleta (Brauer & Bergenstamm, 1891).—Det. A. C. Pont. Prov. Pinar del Rio: Viñales, 3 ♀ 22. VI.; Soroa, 6 ♂ 36 ♀ 4. VIII., 1 ♂, 10 ♀ 28. VIII.; San Diego de los Baños, 21 ♂, 13 ♀ 23. IV; Sierra de Cajalbana (La Mulata), 5 ♂, 41 ♀ 16. VI.; Guajaibon, 1 ♂, 6 ♀ 14. III., 1 ♂, 8 ♀ 3. V.—Prov. Las Villas: Playa Larga, 3 ♂, 7 ♀ 7.—9. VIII.; Playa Larga (El Maíz), 3 ♀ 10. VIII.; Sierra de Trinidad, 530 m, 2 ♀ 30. VI.—Prov. Oriente: La Gran Piedra, 1200 m, 15 ♀ 17. VII.

Graphomya maculata (Scopoli, 1763).

Prov. Habana: Habana—Marianao. 1 ♂ 29. IV., 1 ♀ 10. VI.

**Limnophora narona* (Walker, 1896).– Det. A. C. Pont.

Prov. Habana: Habana, slaughter-house J. A. Mello, 1 ♀ 10. III., (manure).

**Neodexiopsis* sp.—Det. A. C. Pont.

Prov. Las Villas: Sierra de Trinidad, 530 m, 1 ♂ 3 ♀ VI.

Neomuscina ?rufoscutellata Dodge, 1955.—Det. A. C. Pont.

Prov. Pinar del Rio: Viñales, 8 ♂, 11 ♀ 22. VI.; Viñales—Santo Tomás, 2 ♂, 2 ♀ 23. IV.; Soroa, 2 ♀ 14. IV., 6 ♂, 5 ♀ 4. VIII.; San Diego de los Baños, 2 ♂, 5 ♀ 3. VIII.; Sierra de Cajalbana (La Mulata), 1 ♂, 5 ♀ 21. VI.; Guajaibon, 3 ♀ 3. V., 1 ♂ 25. V.—Prov. Habana: Catalina, 3 ♂, 3 ♀ 14. VI.—Prov. Matanzas: Punto Escondido, 1 ♂ 10. IX.—Prov. Las Villas: Playa Larga, 21 ♂, 18 ♀ 9. VIII.; Playa Larga (El Maíz), 27 ♂, 24 ♀ 10. VIII.; Trinidad, 3 ♂, 17 ♀ 29. VI.—Prov. Oriente: Bueycito, 4 ♂, 15 ♀ 14. VII.; La Gran Piedra, 1150 m, 2 ♀ 17. VII.

Cyrtoneurina rescita (Walker, 1861).—Det. A. C. Pont.

Prov. Pinar del Rio: Sierra de Cajalbana (La Mulata), 1 ♀ 21. VI., (Faeces).—Prov. Habana: Cuatro Caminos, 4 ♀ 21. III., (faeces).—Prov. Las Villas: Playa Larga, 1 ♀ 9. VIII., (faeces); Playa Larga (El Maíz), 1 ♂, 5 ♀ 10. VIII., (faeces, meat).

Neomusca sp.– Det .A C. Pont.

Prov. Habana: Habana—Marianao, 1 ♀ 2. VI., (old liver).

Family Calliphoridae

Chloroprocta idioidea (Robineau-Desvoidy, 1830).—Det. M. Z. James.

Prov. Pinar del Rio: Soroa, 1 ♂, 2 ♀ 4. VIII.; Sierra de Cajalbana (La Mulata), 2 ♀ 21. VI.—Prov. Habana: Habana—Marianao, 2 ♀ 30. V., 1 ♀ 7. VI., 1 ♀ 16. VIII.; Catalina, 1 ♀ 14. VI.—Prov. Las Villas: Trinidad, 26 ♂, 23 ♀ 29. VI.; Sierra de Trinidad, 530 m, 4 ♂ 30. VI. –Prov. Oriente: Guisa, 1 ♀ 15. VII.

Cochliomyia macellaria (Fabricius, 1775) and

Cochliomyia aldrichi Del Ponte, 1938. — Both the species were observed practically everywhere, reaching altitudes of about 1200 m o. s. l., (La Gran Piedra, Prov. Oriente).

Cochliomyia minima Shannon, 1926.

Prov. Pinar del Rio: Viñales—Santo Tomás, 1 ♂ ,1 ♀ 23. VI.; Soroa, 2 ♂, 3 ♀ 4. VIII.; Sierra de Cajalbana (La Mulata), 4 ♀ 16. VI.; San Diego de los Baños, 2 ♂, 27 ♀ 23. IV., 4 ♂, 6 ♀ 3. VIII.; Guajaibon, 1 ♂ 14. III., 1 ♀ 3. V., 1 ♂, 1 ♀ 25. 44V.—Prov. Habana: Habana—Marianao, 1 ♂, 1 ♀ 15. III., 1 ♀ 9. VIII.—Prov. Las. Villas: Cayo Lanzanillo, 8 ♀ 12. III. 1965, (leg. V. Černý); Cayo Largo, 7 ♀ 28. IV. 1966, (leg. J. de la Cruz); Playa Larga, 1 ♂ 7. VIII.; Playa Larga (El Maíz), 1 ♂ 10. VIII.; Sierra de Trinidad, 530 m, 2 ♀ 30. VI.

Lucilia (*Phaenicia*) *cluvia* (Walker 1894).

Prov. Pinar del Rio: Guajaibon, 5 ♂ 25. V.—Prov. Habana: Habana—Marianao, 53 ♂, 126 ♀ III. to IX.; Cuatro Caminos, 5 ♂, 6 ♀ 21. V.—Prov. Oriente: Barrancas, 7 ♀ 12. VII.

Lucilia (*Phaenicia*) *?eximia* (Wiedemann, 1830).

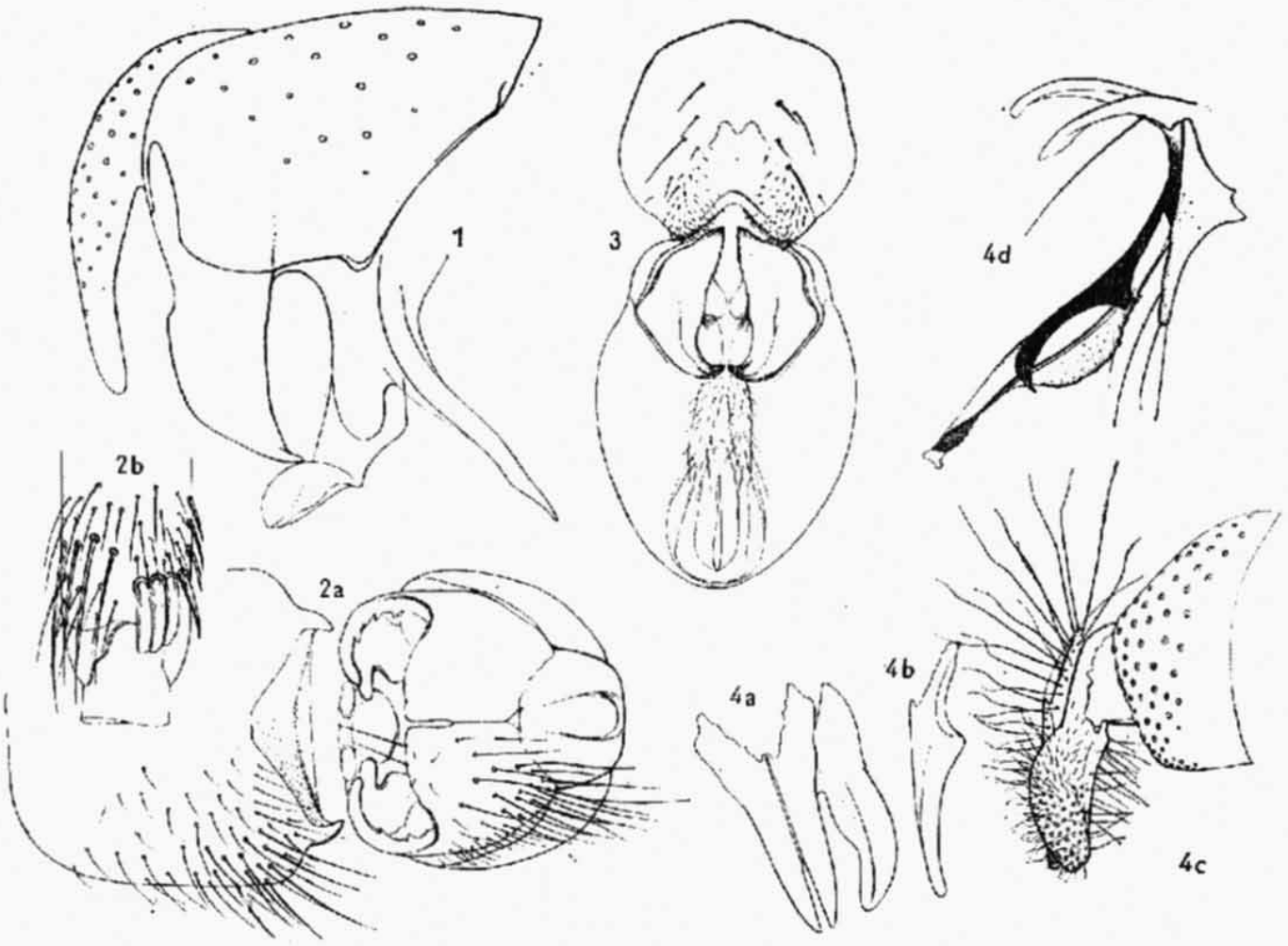
Prov. Pinar del Rio: Soroa, 4 ♂, 16 ♀ 14. IV., 21 ♂, 49 ♀ 4. VIII., 1 ♂, 1 ♀ 28. VIII.; Sierra de Cajalbana, 3 ♂, 40 ♀ 16. VI.; San Diego de los Baños, 2 ♂, 19 ♀ 23. IV.; 1 ♀ 3. VIII.; Guajaibon, 1 ♀ 14. III., 1 ♂, 23 ♀ 3. V., 1 ♂, 3 ♀ 25. V.—Prov. Habana: Habana—Marianao, 78 ♂, 560 ♀ III.—IX.; Habana Santa Fé, 3 ♀ 10. VI.; Cuatro Caminos, 2 ♂ 20. V., 1 ♂, 1 ♀ 18. VIII.; Catalina, 4 ♀ 14. VI.—Prov. Matanzas: Boca de Canasí, 1 ♀ 4. VIII.—Prov. Las Villas: Playa Larga, 2 ♀ 7. VIII.; El Maíz, 3 ♀ 10. VIII.; Trinidad, 2 ♂, 1 ♀ 29. VI.; Sierra de Trinidad, 530 m, 25 ♂, 61 ♀ 30. VI.—Prov. Oriente: Bueycito, 1 ♂, 4 ♀ 14. VII.; La Gran Piedra, 1150—1200 m a. s. l., 57 ♀ 17. VII.—Pinar del Rio: Rancho El Tesoro, XXXX, leg. V. Černý,

Lucilia (Phaenicia) cuprina (Wiedemann, 1849).
Prov. Habana: Habana—Marianao, 1 ♀ 23. V., (cow liver), 1 ♂, 2 ♀ 18. III., (meat).
Note: A few samples are added, collected by other methods than by baiting, including haematophagous or symbovine species.
Family Muscidae
Orthellia caesarion (Meigen, 1826).
Prov. Pinar del Rio: Valley 7 km N from San Diego de los Baños, 300 m, 2 ♀ 23. IV., cow dung.
Haematobia irritans irritans (Linnaeus, 1758), sensu Zumpt, 1973.
Prov. Habana: Habana– Marianao, 1 ♀ 18. III., (on cow); Bello Indio, 4 ♂, 1 ♀ 14. III.
Stomoxys calcitrans (Linnaeus, 1758).
Prov. Habana: Habana—Marianao, 1 ♂ 18. III., (on cow).

TAXONOMICAL NOTES

Several species of a doubtless sanitary importance remained unidentified, or their identification is only preliminary. I therefore give, on this place, their short descriptions together with figures of their most important diagnostic characters. This should make it possible to identify them later and without a necessary study of the original material.
Fannia sp. I, (of the *benjamini*-group of Chillcott, 1960).

Male. Head—Frontal bristles 8—9, regular. Parafrontals silvery, their widest part corresponding to 4/5 of the 3rd antennal segment, parafacials narrow, bare. Ocular



Figs. 1—4. Male genitalia of: 1 *Neomuscina ?rufoscutellata* Dodge, hypopygium, lateral view, aedeagus omited); 2 *Morellia ?semimarginata* Stein, 2 a — hypopygium and 5th sternite ventrally, 2b — the end of 2nd femur dorsally; 3 *Fannia* sp. I, hypopygium and 5th sternite ventrally; 4 *Lucilia ?eximia* (Wied.), 4a — cerci and surstyli posterally, 4 b — cerci laterally, 4 c — hypopygium laterally, 4 d — aedeagus.

interdistance 1 plus 1/3 of 3rd antennal segment. Antennae ochraceous, 3rd segment ± brownish. Palpi yellow, subspatulate. Thorax—densely greypollinose, the median vitta and the very broad lateral vitta dark brown. Bristles pra short, not differentiated from microchaetae, acr-mi in three irregular rows. Abdomen — second and third segments ± translucent yellow, median vitta brown, anterally darker, lateral spots big, indistinct, dilated towards hind margins of tergites. Preagenital segment ferruginous, pollinose. Wingsvery light brownish, veins ochraceous. Legs—predominantly brownyellow, all tarsi dark brown, t_2 slightly club-formed, ventrally densely and shortly pubescent. Chaetotaxy without special thorns or tufts. Hypopygium as in Fig. 3, ochraceous, 5th sternum grey-brownish with one yellow spot medially.
Female. Dark spots on abdomen less distinctive; paired, yellow, well defined spots on 2nd—5th abdominal segment may be reduced in some individuals. Legs darker, as a rule, than in males.

Morellia ?semimarginata (Stein).

Body black, intensive green shining, only the acrostichal pronotal strip pollinose. Wings spotted: transverse veins infuscated, t_a with a rounded spot followed by a broad shade reaching subcostal cell. Hypopygium as in Fig. 2.

Lucilia (Phaenicia) ?eximia (Wied.)*)

According to James (1970) 5 species of the genus *Lucilia* (s. l.) are known to occur in Cuba. In our materials, besides the simply determinable *L. cluvia* L., there are numerous specimens of some other species, which may be identified, only with reservation, as *L. eximia* (Wied.). The differences, when compared with diagnoses, key characters and figures in Hall (1958) and Aubertin (1933) appear to be following:
1. Second tibia with only one ventral, 2 posteral and 1 anterodorsal bristles, the distinctive pd being still absent.
2. Lower squamal lobe and the marginal part of upper squamal lobe are pale brownich, not "brown".
3. Basicosta not "brown to brownish black" (Hall), but pale yellow to brownish, newer brownish black.
4. In male genitalia (Fig. 4a—d), the paralobi, in a lateral view, are strongly convex backwardly (contrary to figures in Hall and Aubertin), fore parameres are apically dilated to form a slender projection and, thus, not broadly triangular shape as in fig. F, pl. 24, in Hall.

Musca domestica L.

Hennig (1962) believes that there do not exist immediate historical relations between the New World and the Old World subtropical to tropical populations of *M. domestica*, which are given the name *vicina*. As far as I am able to state, the Cuban populations are phenotypically conform with the vicina form of the Old World. Our material is too limited in male specimens, which makes it impossible to study it from biometrical point of view.

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*) Shortly before finishing the manuscript of this paper, M. T. James described *Lucilia retroversa* James (James M. T., Two new species of *Phaenicia* from the West Indies (Diptera: Calliphoridae). Proc. Ent. Soc. Wash. 73: 381—385, 1971) from Cuba, based partly on my own material. For the case I could detect some practical characters between the females of *L. eximia* and *L. retroversa*, I should try to identify all the specimens of my Cuban collections and to publish in a next paper on Cuban Diptera.

Table 1. The composition of the fauna of Anthomyiidae, Muscidae and Calliphoridae in various habitats in Cuba.
Habitats: 1 + 2 — tropical forest, 3 — partially deforested forest for grazing, 4 — bush, pasture-land, 5 — coastal bush (no grazing), 6 — seashore (no grazing), 7 — pasture-land with intensive grazing, 8 — pinetum, 9 — suburban area of Havana. The numbers represent the average number of individuals baited within one hour. + = less than 1 specimen in an hour. Faeces above, meat below. See text and my previous paper (Gregor 1972).

	Habitat	1 + 2	3	4	5	6	7	8	9
	Number of samples	17	9	11	4	5	3	4	183
A.	*Calythea micropteryx*	13	260	43	9	5	3	42	55
		+	+						+
Muscidae	*Fannia pusio*	1	9	3					+
		69	110	18					6
	Fannia sp. 1.	1	42	1					+
		4	261	11			3	2	1
	Musca domestica		+			+			+
				2					20
	Morellia basalis	13	250	14				34	16
		+							+
	Morellia? semimarginata	3	300	1				30	
		+	17						
	Synthesiomyia nudiseta		+						1
		1	10	9					9
	Ophyra aenescens		2					2	+
		23	270	17				17	2
	Ophyra cubana		8						
		52	116	—					
	Gymnodia arcuata	32	115	25	+	5	9	65	14
		8	9						+
	Atherigona orientalis	+	+						1
		2	7	30			2		7
	Myospila absoleta	10	82	—				23	
		3							
	Neomuscina rufoscutellata	1				5	12	2	
		94	10	14				22	
	Cyrtoneurina rescita	3					11	2	
		+							
Calliphoridae	*Chloroprocta idioidea*		2	1					+
			+	8					+
	Cochliomyia macellaria	4	9	9		5	3	13	7
		130	280	190	1	2	53	35	95
	Cochliomyia aldrichi	4	1	4		4	2		11
		39	72	10		2	3	16	114
	Cochliomyia minima		11					2	
		9	21	6				5	+
	Lucilia cluvia								5
							2		4
	Lucilia ?eximia	3	86					21	22
		10	13	11				2	12

A. = Anthomyiidae

CHOROLOGY

Similarly as in a previous paper (Gregor 1972), I am trying to compare the composition of fly-populations in various habitats, which are characterised in the paper mentioned. The result (see Table 1) appears to be a very approximate picture of true relation only, which is due to limited number of samples and to scattered data of sampling. The habitat Nr. 9 only (suburban area of Havana) is representatively characterised as far as number of samples is concerned. Despite of this fact, the schematic representation makes it possible to state certain phenomenons.

1. There exist obvious qualitative differences in species spectra:

a) Forest habitats (biocenoses) are the richest localities, especially if influenced by anthropurgic factors. Most species of Muscidae reached their highest densities in this sort of habitats.

b) Non-forested habitats (seashore, pasture-land) are considerably poorer, missing characteristic or dominant species (the relatively rich represented *Cyrtoneurina rescita* in habitat 7, is probably exceptional).

c) Anthropobiocenosis (habitat 9) is, contrary to forest biocenoses, poorer in Muscidae, both in qualitative and quantitative respect.

2. Affinity of individual species to different habitats.

a) In most species, it is possible — at least approximately — to define their ecotopy and the degree of their synathropy (detailed data are given in the characteristics of single species, in this paper).

b) Only two species could be observed to be more abundant in the anthropobiocenosis than in more natural habitats: in *Cochliomyia aldrichi*, there exist only quantitative differences, which characterise this species as a hemisynanthrope inclining towards eusynanthropy, and *Musca domestica vicina*, the behaviour of which, in Cuba, is purely eusynanthrope.

SEASONAL INCIDENCE

The seasonal changes of incidence in the 9 most important species are shown in Fig. 5, where the average numbers of individuals are given. They were baited in periods of fourteen days, from March to September 1966. More detailed data on conditions of weather during this time are given in a recent paper (Gregor 1972).

The schematic representation indicates distinctive quantitative changes in the density of imagoes during this period, mainly concerning the dominant species of the genus *Cochliomyia*. In all the four species of the family Calliphoridae the gap between culminations of density is nearly equal (about three months) and coinciding in time. *Musca domestica* and *Ophyra aenescens* show one distinctive peak (gradation) in May and June; in the end of winter and in the end of summer, too, the indication of increasing abundance interrupted by zero values is visible. *Gymnodia arcuata* and *Atherigona orientalis* show—similarly as all other species of the spectrum—the decrease of abundance in the begining of spring and a less distinctive gradation, when compared with Calliphoridae, one month later in summer. A low but nearly constant abundance during spring and summer is seen in *Synthesiomyia nudiseta*. A completely different course of abundance may be seen in *Calythea micropteryx* with its maximum in March when it was a dominant species and with the following strong decrease since the middle of spring to the complete absence of this species in the end of summer.

We may observe profound changes of population density, the causes of which I hope to partly explain in my next paper after identification of remaining families of flies and after confrontation with meteorological data.

CHOICE OF FOOD IN ADULT FLIES

It this chapter, I am trying to characterize, for each species, the register of food sources indicating indirectly the ability of possible vectoring microbes, and, on the other hand, the preference of the two main categories of food in adult flies — namely faeces and decaying meat.

Table 2. The attraction of various types of bait to Anthomyiidae, Muscidae and Calliphoridae at a time baiting. Females above, males below. (See text.)

Species \ Bait	Old meat, (mixture)	Old cheese	Fresh human faeces	Cow dung	Fruit (mango)
Calythea micropteryx			5	8 1	
Fannia pusio	2			1	
Fannia sp. I		4			
Musca domestica	6 1				1 4
Morellia basalis			2 2		
Synthesiomyia nudiseta	2	2	1		1 2
Ophyra aenescens	1				
Gymnodia arcuata		1	6	6	
Atherigona orientalis	1				
Cochliomyia macellaria	20 5		1 1		4 3
Cochliomyia aldrichi	41 16	3 2	5		
Lucilia cluvia	1 1				
Lucilia ?eximia	1	6 5	4	1	1 4
Total	98	23	27	17	20
Number of species	9	5	7	4	4

In case of only one sex collected only females are represented, except for *Ophyra aenescens*.

Table 2 indicates the results of four-hour baiting on five different substrates, which took place in the garden of the Biological Institute in Havana between 9.00 a.m. to 1.00 p.m. on April 5th, 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 results of this short-lasting

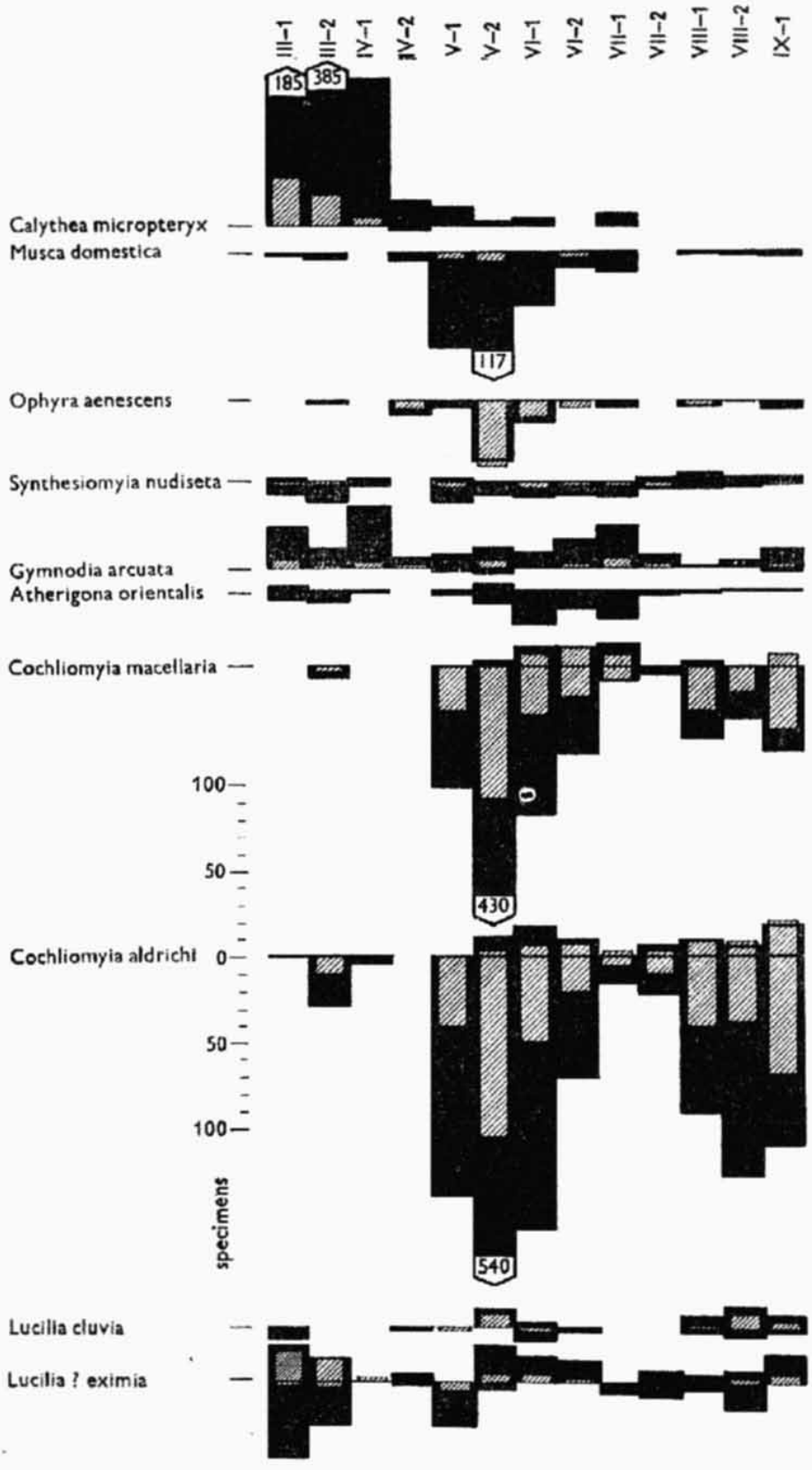

Fig. 5. The seasonal fluctuations of the most important synathropic species of Anthomyiidae, Muscidae and Calliphoridae, from March to September 1966, in Havana. (See text).

Table 3. The attraction of various types of bait. A comparison of the abundance of Anthomyiidae, Muscidae and Calliphoridae trapped between March to September 1966 in stationary locality of Havana. The numbers represent the average number of individuals baited within one hour (females above, males below). + = less than 1 specimen in an hour.

Species \ Bait	Old beef meat	Old beef liver	Tinned meat of big moluscs	Fresh human faeces	Old human faeces (24—32 hours)
Calythea micropteryx				97 5	14 1
Fannia pusio	6	5 1	5 +	+	
Fannia sp. I		1	+	1	
Musca domestica	1	38 1	32 1	1	
Morellia basalis				15 8	7 8
Synthesiomyia nudiseta		8 2	5	1 +	1 +
Ophyra aenescens	1 +	4 2	9 12		
Gymnodia arcuata				20 2	5 1
Atherigona orientalis	6	10	2	+	
Chloroprocta idioidea		1	+	+	
Cochliomyia macellaria	5 8	95 35	104 25	4 2	3 1
Cochliomyia aldrichi	31 15	186 92	197 67	6 2	3 2
Lucilia cluvia		3 1	1 1	4 1	1
Lucilia ?eximia		1 +	2	14 3	21 4

In case of only one sex collected, only females are represented.

test are limited as for their representativeness. As far as single species are concerned, the widest trophical potency was shown by *Lucilia ?eximia*, *Synthesiomyia nudiseta* and by *Cochliomyia macellaria* and *C. aldrichi*. It is interesting to note the different behaviour of *C. macellaria* and *C. aldrichi* towards cheese and fruits. It is impossible to strictly eliminate schizophagous (carnivorous) species, as they mostly visit, at least

facultatively, other substrates. Only in coprophagous species *Calythea micropteryx* and, to some degree, also in *Gymnodia arcuata*, a strict preference of faeces could be observed. A very characteristic combination of meat (7 individuals) and fruit (5 individuals) is seen in *Musca domestica* being less distinctive also in *Cochliomyia macellaria*. From the viewpoint of attractiveness, meat was in the first place, followed by faeces and cheese, cow dung being attractive obviously for distinctly coprophagous species *C. micropteryx* and *G. arcuata*.

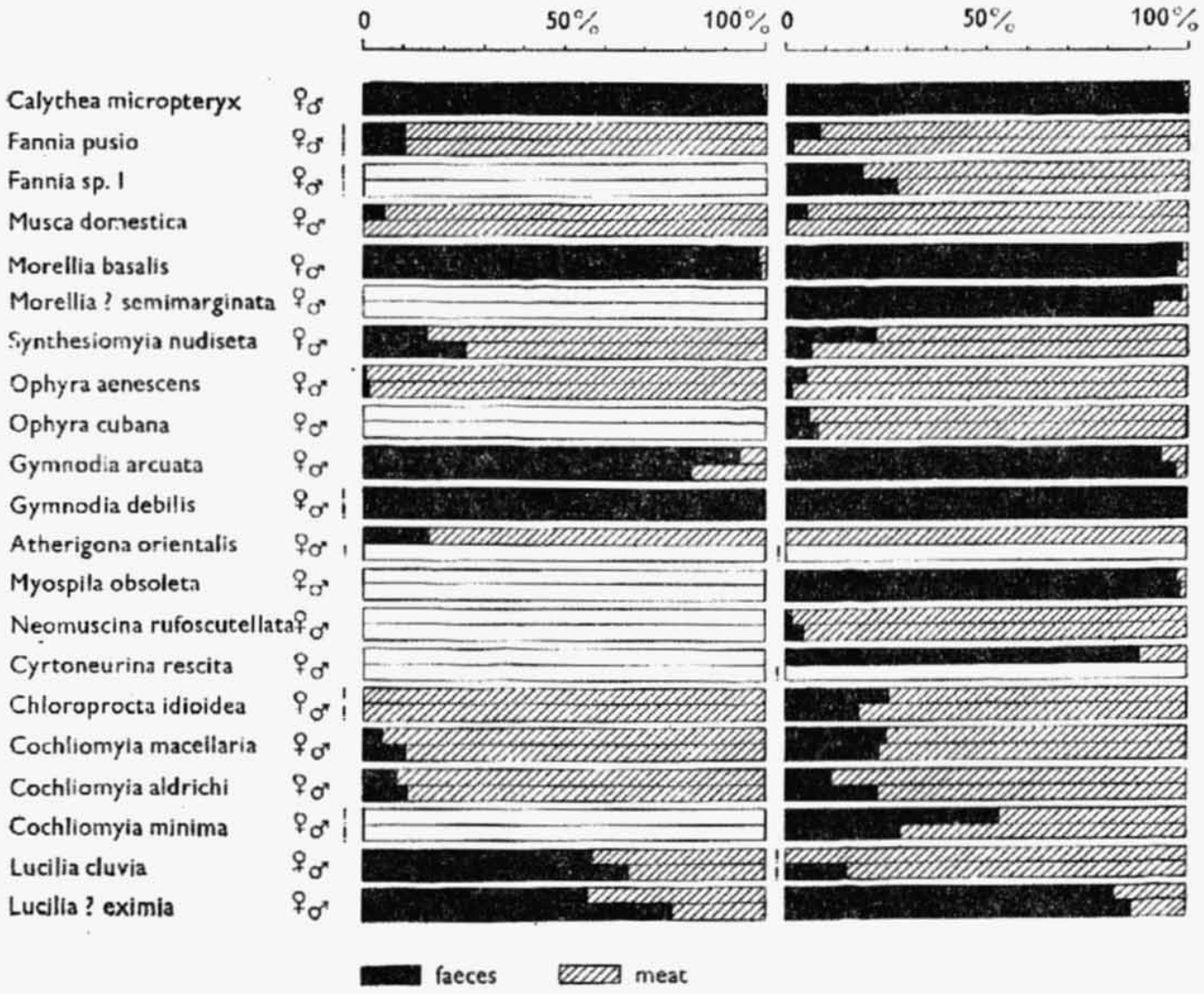

Fig. 6. Relative abundance of Anthomyiidae, Muscidae and Calliphoridae on tinned meat and human faeces. Left Havana, right diverse localities in Cuba. (See text). ! = less than 20 specimens.

In the Table 3 the attractiveness of various types of baits (substrates) for blowfly and muscoid fly species during a total of half a year is given. In visiting various sorts of meat only little quantitative differences are visible. The only striking phenomenon is the complete absence of the genus *Lucilia* (s. l.) on beef meat. (The difference between meat and faeces, as categories, is best visible in Fig. 6.) The next important and interesting phenomenon is the fact that faeces remain attractive as long as three days. Qualitative and quantitative differences in frequenting fresh and one-day-old faeces are not representative. In old faeces the spectrum of visitors is missing species frequenting faeces more or less facultatively only (*Fannia pusio*, *Fannia* sp. I, *Musca domestica* and *Atherigona orientalis*). In obligatory coprophagous species the decrease of attractive-

ness is striking in *Calythea micropteryx* and *Gymnodia arcuata*, less distinct in *Morellia basalis*. *Cochliomyia macellaria* and *C. aldrichi* do not discriminate between fresh and old faeces and the number of *Lucilia ?eximia* increased, moreover, in old faeces reaching high abundance on this substrate up to get dominant on it.

Fig. 6 is a comparison of discrimination between decaying meat and faeces in single species, based on our materials, as a whole. In Calliphoridae, there do not exist cleancut visitors of one of these two substrates, whereas the species of the genus *Cochliomyia* and *Chloroprocta* prefer slightly meat to faeces. In Muscidae (and Anthomyiidae), there exist, in the contrary, quite cleancut categories: genera *Morellia*, *Myospila*, *Gymnodia* and *Cyrtoneurina* comprise strictly coprophagous representatives, *Ophyra* and *Neomuscina* are strictly carnivorous, *Atherigona orientalis* and *Synthesiomyia nudiseta* prefer slightly meat to faeces. *Musca domestica* appears, in this case, to be distictly carnivorous, only 4—5 % females visit also faeces, males being absent from this substrate. They also occasionally visit other substrates.

Table 2 is of locally and phenologically limited value, since it is based on less numerous material. Contrary to this, in a long lasting average (Fig. 6, Table 3) there are some striking differences between individual samples concerning selection of substrates. This is specially the case of both the species of *Lucilia* (*cluvia* and *? eximia*), less distinctively also of the species of *Cochliomyia* and *Musca domestica*. In Fig. 5 *L.? eximia* appears to be rather striking, since it rather alternated in frequenting meat and faeces. For example, in the second half of March and in the first half of May as well, *L. ? eximia* frequented meat only, since this time to the end of June, they frequented practically faeces only. In the first half of March, males of this species preferred strictly faeces, females preferred meat. In *Cochliomyia macellaria* and *C. aldrichi*, a similar phenomenon could be observed, males and females visiting during the second gradation (in May) meat only, and as long as one month later they also appeared on faeces. The same was the case during the third gradation.

CLASSIFICATION

1. *Calythea micropteryx* Thoms. Limited communicative hemisynanthrope and symbovine, distinctly coprophagous, mostly on fresh cow dung. It characterizes the spring aspect of fauna being, in March, mostly the absolutely dominant dipteron on cow dung. In summer months its occurrence appears to be latent. Sex ratio of females to males is 15 : 1.
2. *Fannia pusio* (Wied.). Communicative hemisynanthrope, preferring meat to faeces. Rather stenotope, preferring forest eubiocenoses where it belongs to dominant species. Maximum occurrence in high summer. Sex ratio varies, females are mostly prevailing.
3. *Fannia* sp. I. Communicative hemisynanthrope, slightly preferring meat to faeces, but also liking cheese. In anthropobiocenoses nearly missing, but frequently dominant in forests. Females distinctly prevail.
4. *Musca domestica* L. Communicative eusynanthrope. In samples taken outside buildings it prefers meat, mainly intestine, but visits also fruit, whereas on faeces it appears occasionally. Trophically and ethologically, it greatly resembles the nominate *M. domestica domestica* of temperate zone, outside buildings. Urban populations are less dense, they got comparatively abundant in May. In free nature no free-living populations could be observed. In samples, females distinctly outnumbered the males.
5. *Morellia basalis* (Walker). Weakly communicative hemisynanthrope, obligatory coprophagous, but not visiting beef faeces, liking also cheese. Probably skinophilous. It prefers habitats with vegetation of trees and shrubs, being often dominant in thin forests. Maximum flight between may to August. Sex ratio in equilibrium.

6. *Morellia ?semimarginata* (Stein). Weakly communicative hemisynanthrope, obligatory coprophagous and probably skinophilous, being sometimes dominant in thin forests of higher elevations. Missing in anthropobiocenoses. Sex ratio varies, mostly females are prevailing.
7. *Synthesiomyia nudiseta* (Wulp). Communicative hemisynanthrope preferring meat, but liking also cheese, being less frequent on human faeces. Eurytopic with very balanced abundancy and frequency during the season and not tending to gradations. Females strongly prevail.
8. *Ophyra aenescens* (Wied.). Weakly communicative hemisynanthrope, visiting obligatorily various sorts of decaying meat, but seldom on human faeces. It prefers forest habitats, where it belongs to dominant species on meat, less abundant in anthropobiocenoses. A weak increase in numbers was observed in the end of May. The sex ratio may rather vary, but it is rather equal, in average.
9. *Ophyra cubana* Gregor. Weakly communicative hemisynanthrope, visiting obligatorily meat, exceptionally human faeces. It only occurs in forest habitats representing there mostly a very abundant species. Female sex prevails. Probably a species endemic to Cuba.
10. *Gymnodia arcuata* (Stein). Communicative hemisynanthrope and symbovine, visiting mostly human and beef faeces, facultatively meat and cheese. Eurytopic, probably herbicolous species, being subdominant to dominant all the season on pastures. Females visibly prevail to males.
11. *Atherigona orientalis* Schin. Weakly communicative hemisynanthrope, visiting obligatorily meat and facultatively faeces. Eurytopic, less frequent and mostly not abundant. Most numerous in June and July. Only females could be baited.
12. *Myospila obsoleta* (Brauer et Bergenstamm). Weakly communicative hemisynanthrope visiting human faeces, not observed on cow dung and facultatively on meat. It is confined to forest and pasture forests, where it is getting subdominant in summer; missing in anthropobiocenoses. Sex ratio varies, mostly females are prevailing.
13. *Neomuscina ?rufoscutellata* Dodge. Communicative hemisynanthrope, preferring meat and cheese, being exceptional on human faeces. It accompanies forest eubiocenoses, being frequent and abundant, on meat often subdominant. Not observed in anthropobiocenoses. Females distinctly prevail.
14. *Cyrtoneurina rescita* (Walk.). Weakly communicative hemisynanthrope, visiting obligatorily human faeces. Rather infrequent and not dominant, not observed in anthropobiocenoses.
15. *Chloroprocta idioidea* (R.—D). Communicative hemisynanthrope, without distinctive trophical preferrence (meat, human faeces and fruit). Less frequent, being abundant in seldom instances only. Psychrophilous, being on the wing also if it rains. Sex ratio varies.
16. *Cochliomyia macellaria* (Fabr.). Communicative hemisynanthrope preferring meat to human faeces, but liking fruit. Heliophilous and thermophilous. Striking differences of local and phenological character exist in density, gradations repeat after 2—3 months. Eurytopic species, avoiding larger areas without vegetation. Maximum occurrence in the second half of May. Sex ratio of females to males is 3.5 : 1.
17. *Cochliomyia aldrichi* Del Ponte. Communicative hemisynanthrope inclining towards eusynanthropy. It prefers meat to human faeces, likes cheese. Heliophilous and thermophilous. The periods of gradations similar as in *C. macellaria*. In free less abundant, but in suburban and urban areas more numerous than *C. macellaria*. Maximum occurrence in second half of May. Sex ratio of females to males is 3 : 1.
18. *Callitroga minima* Shann. Communicative hemisynanthrope, preferring slightly meat to human faeces, but liking fruit, too. This species is confined to eubiocenoses being less frequent and only scarcely abundant. Females mostly prevail.

19. *Lucilia cluvia* (Walk.). Communicative hemisynanthrope, inclining possibly towards eusynanthropy. It prefers fresh human faeces to older faeces and to meat. In free nature rather rare, never observed in forest biotopes and never abundant. Sex ratio varies, mostly females are prevailing.
20. *Lucilia ?eximia* (Wied.). Communicative hemisynanthrope distinctly preferring human faeces to meat, being rather frequent on one-day-old faeces, representing there a dominant species, but frequently also on cheese and fruit. On certain occasions, sudden changes in the preferrence of faeces to meat could be observed. An eurytopic species, but visibly more abundant in eubiocenoses of forests or in habitats with rich vegetation. Sex ratio strongly varies, females prevail (5 : 1), in average.

SUMMARY

By the method of baiting outside buildings and in free nature in different localities of Cuba the material of more than 22 thousand flies of the families Anthomyiidae (1 species), Muscidae (20 species) and Calliphoridae (7 species) was collected, between March 3rd to Septembre 15th 1966. Nine species of them are first recorded from Cuba, one species is new to science.

About 20 of these species may be eliminated as synanthropes. Of these, only one appears to be eusynanthropic (*Musca domestica*), the remaining being hemisynanthropic, of which *Cochliomyia aldrichi* and *Lucilia cluvia* are weakly tending towards eusynanthropy.

Under suburban conditions, as a rule, *Cochliomyia aldrichi* appeared predominant (together with *C. macellaria*. in some instancies), *Musca domestica* playing obviously a less important role. The remaining species, mainly of the family Muscidae, are more or less confined to the presence to vegetation. Quantitatively and qualitatively, the richest habitat is represented by the tropical rain forest, slightly influenced by grazing and/or by anthropurgic factors. The habitats lacking the vegetation of trees and shrubs are both qualitatively and quantitatively poor in Calliphoridae and Muscidae — contrary to Sarcophaginae (viz. Gregor 1972). Five species of Muscidae and one species of Calliphoridae were absent from anthropobiocenoses belonging obviously to the component of coprophagous and cadavericolous reducers of the original Cuban eubiocenoses.

During the period studied, it was possible to observe, in most species, considerable changes of abundance, resembling often periodical overpopulations of flies within the time of about three months. Specifically different seasonal dynamics was observed in the Anthomyid *Calythea micropteryx*, which was the predominant coprophagous species during May, but which nearly completely disappeared during the summer.

In all the species, the food-preference of adult flies was followed. In Muscidae and Anthomyiidae, the flies are usually definite coprophagous or schizophagous, in Calliphoridae, the members of Chrysomyinae (*Cochliomyia, Chloroprocta*) prefer meat to human faeces, contrary to the species of *Lucilia*. Cow dung was obligatorily visited by 2 species only. *Musca domestica vicina* appeared schizophagous visiting only exceptionally human faeces (outside buildings), similarly as its nominate form of the Temperate Zone.

All the chorological, ecological and trophical data, concerning or illustrating possibly the character of synanthropy in the single species, are incorporated into the classification of the most important species. Similarly as in Sarcophaginae (viz. Gregor 1972) and for the same reason, it was impossible to express the grade of synanthropy in the single species by a form analogical with Nuorteva's "index of synanthropy" (Nuorteva 1963, p. 31).

СИНАНТРОПИЯ У МУХ СЕМЕЙСТВ ANTHOMYIIDAE, MUSCIDAE И CALLIPHORIDAE (DIPTERA) НА КУБЕ

Ф. Грегор

Резюме. Квалитативно и квантитативно проанализирован материал 22 302 мух семейств Anthomyiidae, Muscidae и Calliphoridae, собранный в ловушках на Кубе в 1966 г. У 20 видов установлена относительная плотность, сезонная встречаемость и предпочитаемая пища. У мух — потенциальных переносчиков болезней человека дана экологическая характеристика и классификация синантропии.

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S. O. Vysotskaya, M. K. Daniel: Chlenistonogiye gnezd melkikh mlekopitayushchikh. Metody parazitologicheskikh issledovaniy No.7 (Nest arthropods of small mammals. Methods of parasitological investigations No. 7).

Publ. House Nauka, Leningrad, 1973, 72 pp., 46 Figs.

A large number of arthropods is of medical and economic importance throughout the world. Many species of this abundant animal group are dangerous and direct parasites of man, production animals as well as culture plants. They are, however, of paramount importance as regards their participation in the circulation of causative agents of different infections in nature, frequently resulting in epidemic outbreaks inflicting injury and death to man, domestic and game animals. On the other hand, some representatives of arthropods participate in the fertilization of soil or are in other way beneficial to man. This fact prompted the authors S. O. Vysotskaya and M. Daniel to detailed studies of biological laws governing the occurrence of arthropods in nature. On the basis of long term studies on the problems of athropod concentration in nature the authors soon learnt that it is the nests of small terrestrial mammals where the insects and other groups of arthropods find optimal life conditions. Nests of the most different species of small terrestrial mammals, their localization in nature, nest building material, activities of nest inhabitants etc. are very important factors in natural foci of diseases. The long-term studies of the authors and their results should be therefore welcomed and highly appreciated. The present treatise, amounting to 72 pages, covers a complex of