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CAPTURE OF CALIPTRATE FLIES WITH DIFFERENT BREEDING SUBSTRATES ON BEACHES IN RIO DE JANEIRO, RJ, BRAZIL

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Muscidae flies belonging to four Familia and 13 species in a total number of 3,652 specimens were collected from beaches at Ilha do Governador, Rio de Janeiro, Brazil using different breeding substrates, and subsequently bred in the laboratory. Captures were done from April to November 1989, using in a first phase different substrates: fruits (banana and papaya), vegetable (tomato), animal viscera (bovine liver), marine animals (fish, crab, shrimp, squid), mouse carcass and feaces (human and canine). The species collected more often were: Fannia *sp. (subgroup pusio),* Chrysomya megacephala, Phaenicia eximia, Synthesiomyia nudiseta, Peckya chrysostoma, Musca domestica *and* Atherigona orientalis. *In a later phase, only fish was used, as bait and placed directly on the beach sand. From a total of 189 pupae, the following adult specimen were obtained:* Peckya chrysostoma *(58.06%),* Chrysomya megacephala *(30.64%) and in lesser numbers* Synthesiomyia nudiseta *and* Phaenicia eximia.

Key words: Calyptrate flies - breeding media - beaches

Decomposing organic materials carried by the movement of the tide are constantly deposited on the seashore. Such materials are used as food and substrate for ovi and larviposition by arthropods, such as a number of species of muscidae Diptera. In such breeding sites we may find carcasses of marine and other animals, algae, fruit or vegetables left by people, as well as feaces from different animals. However, for the development of the larval stages of those insects the right localization of substrates is of vital importance. A beach area may be divided in three zones: (1) Low litoral zone (constantly covered by the sea water); (2) Medium litoral zone (limited by the medium high tide and the medium low tide); (3) Upper litoral zone (limited by the medium high tide and the final band of sand) (Pearse et al., 1942). The low zone is unsuitable for the development of muscidae larvae, but from the medium zone upwards it becomes viable. Few Familia like Tetinidae and Ephydridae have been found fixed at the level of the medium zone, breeding on algae substrates. Species such as *Hecamedi albicans* (Meigen) (Ephydridae), *Conioscinella hinkleyi* (Malloch) (Chloropidae), *Coproica vagans* (Haliday) and *C. hirtula* (Rondani) (Sphaeroceridae) were breed from specimens collected on the crustacean *Limulus polyphemus* on beaches of New Jersey, U.S.A. (Norrborn, 1983). Accordingly to Souza Lopes (personal communication), the genera *Sarothromyia* and *Tricharea* (Diptera: Sarcophagidae) have their natural restricted to beach areas, breeding on the substrates brought by tide movements. Data on this subject however are scarce and becomes even rarer when concern is put on the type of substrates used for breeding.

The present paper continues a series of previous publications on muscoids breeding substrates (d'Almeida, 1986, 1988, 1989). The work was carried out on beaches in the municipal district of Rio de Janeiro, aiming basically at two points: (a) the assessment of the preference for different breeding substrates shown by the caliptrate fauna when outside the influence of the tide; (b) the evaluation of the muscoid fauna breeding on fish substrates exposed to the insects directly on the beach sand and under the influence of the tide.

MATERIALS AND METHODS

The present work developed in a beach area of Ilha do Governador, was carried out in two phases: on the first, different substrates were

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exposed to the flies inside supports made of cilindric 10 cm x 15 cm empty oil tins; on the second, only one substrate was placed directly on the beach sand.

The tins used in the first phase had their tops trimmed off, were washed and filled with sawdust up to the middle. On the top of the sawdust, nearly 60 g of substrate was placed. The tins were then clutch underneath tables made of pieces of wood which measuring 150 cm x 30 cm provided of 130 cm long stakes to be thrusted in the sand (Fig. 1). The substrates were exposed to the muscoids for oviposition during five days, using two tins per substrate, distributed by three tables, in a distance of 3 m between them, with a total of 12 substrates per sample.

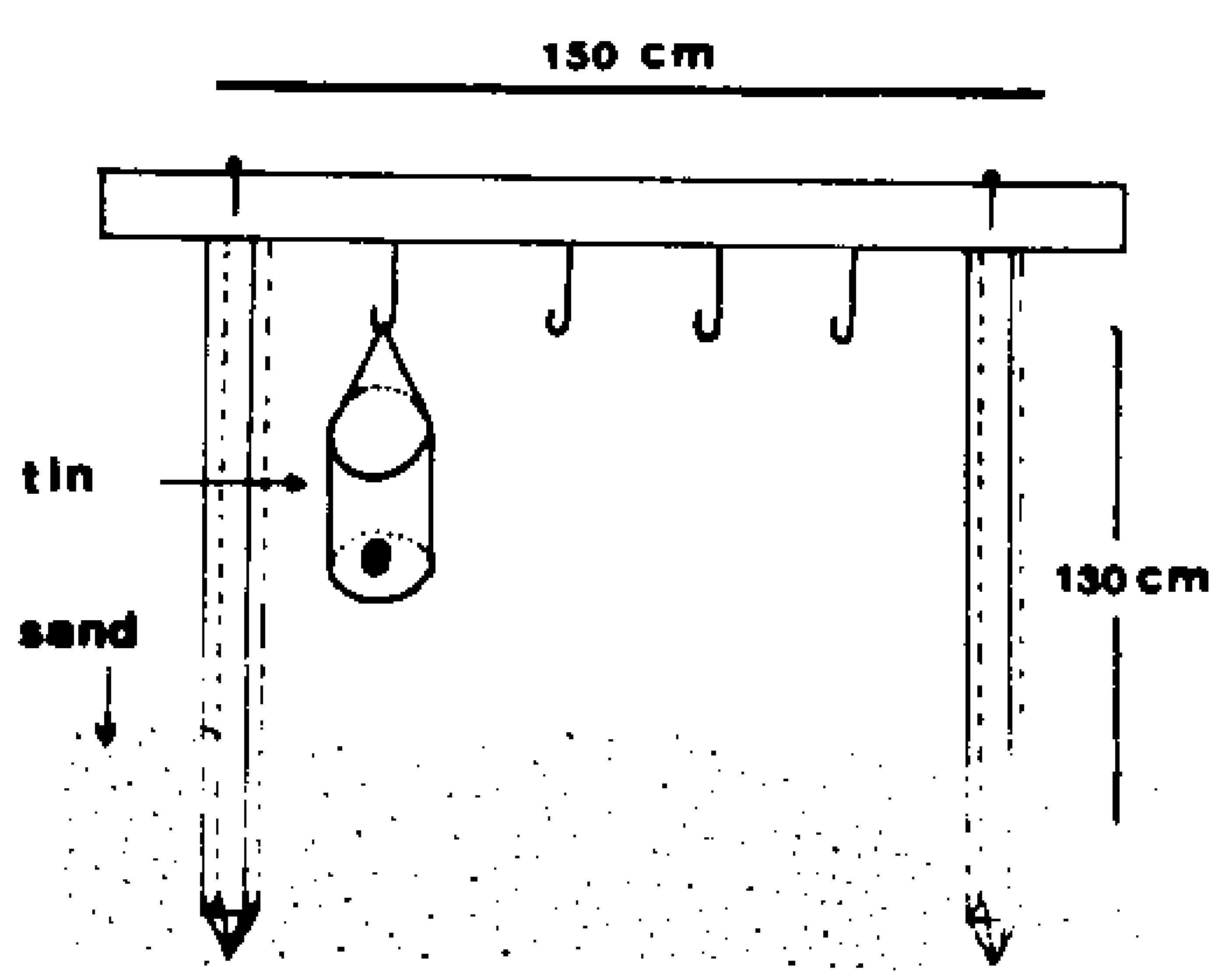

Fig. 1: device placed on the sand to fix the breeding cans containing different substrates (1st stage of the work).

These tables were placed on the limit of the high tide, within the upper litoral zone of a beach located near to the radio station of the Ministery of the Navy and the swamp of the Jequiá river (22°54'23" – South; and 43°10'21" West) (Fig. 2). At the end of the exposition period the tins were taken to the laboratory, attached to plastic bags to avoid escapes and kept at room temperatures ($\bar{X}$ = 24 ± 2 °C). After emergence of adults in the plastic bags, these were removed for specific identification by daily record.

The substrates used were: fruit (banana and papaya), vegetable (tomato), animal viscera (bovine liver), marine animals (fish, crab, shrimp, squid), mouse carcass and feaces (from man and dog). The vegetable and fruits used were ripe and mashed with yeast.

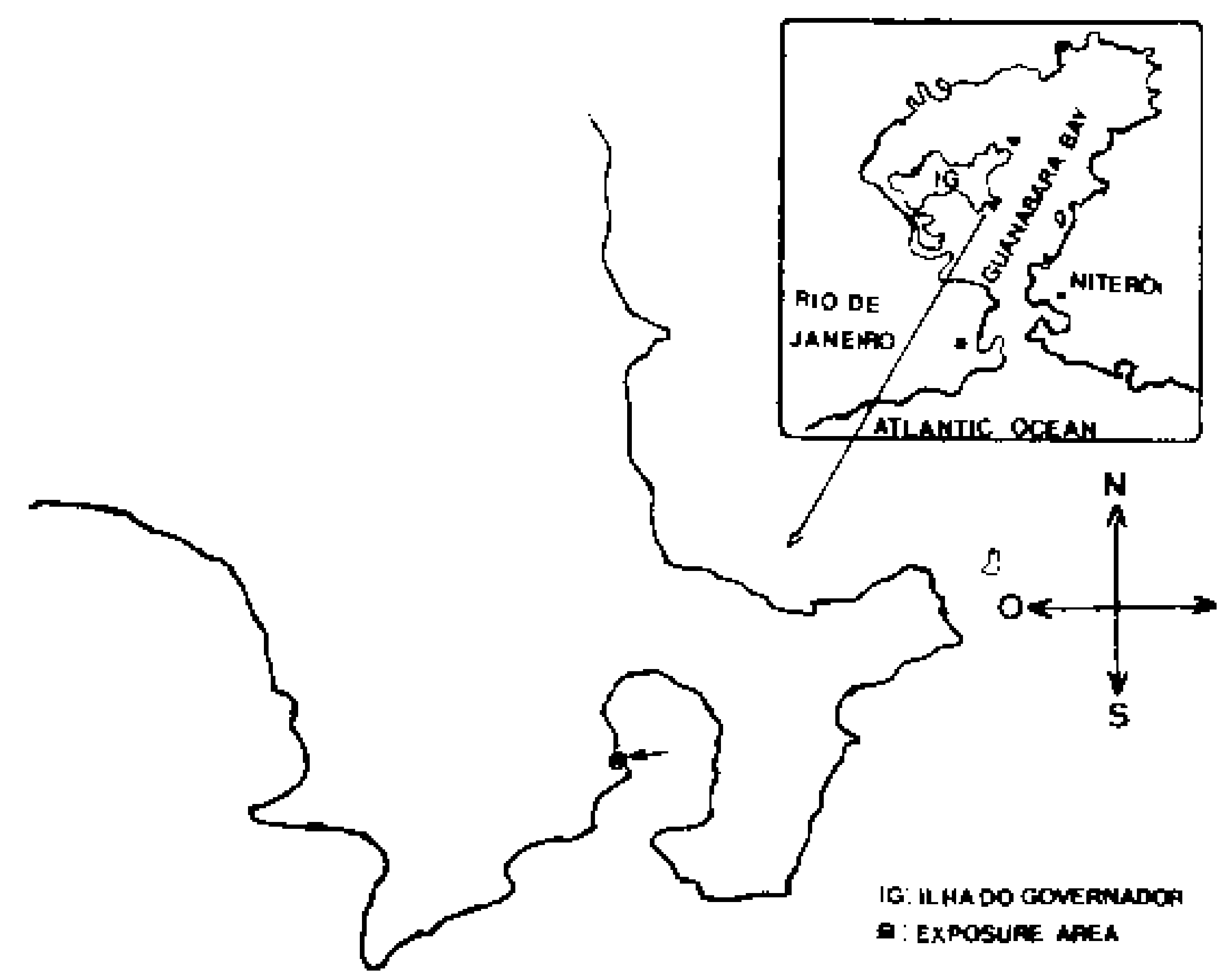

Fig. 2: geographical situation of the studied area (Ilha do Governador, Rio de Janeiro, RJ).

At the second part of the research, the substrate was placed directly on the beach sand at the same sites of the previous experiment. A wooden box measuring 30 cm at each side, without top and botton was placed around the substrate (Fig. 3). The box was fixed to four stakes, 30 cm long, these being thrusted in the sand. A wire netting covered the top of the box, whose botton touched the sand. This device avoided the assaut of other animals, allowing the access of the insects to the substrate as well as the exposure of eggs and larvae to the tide effects.

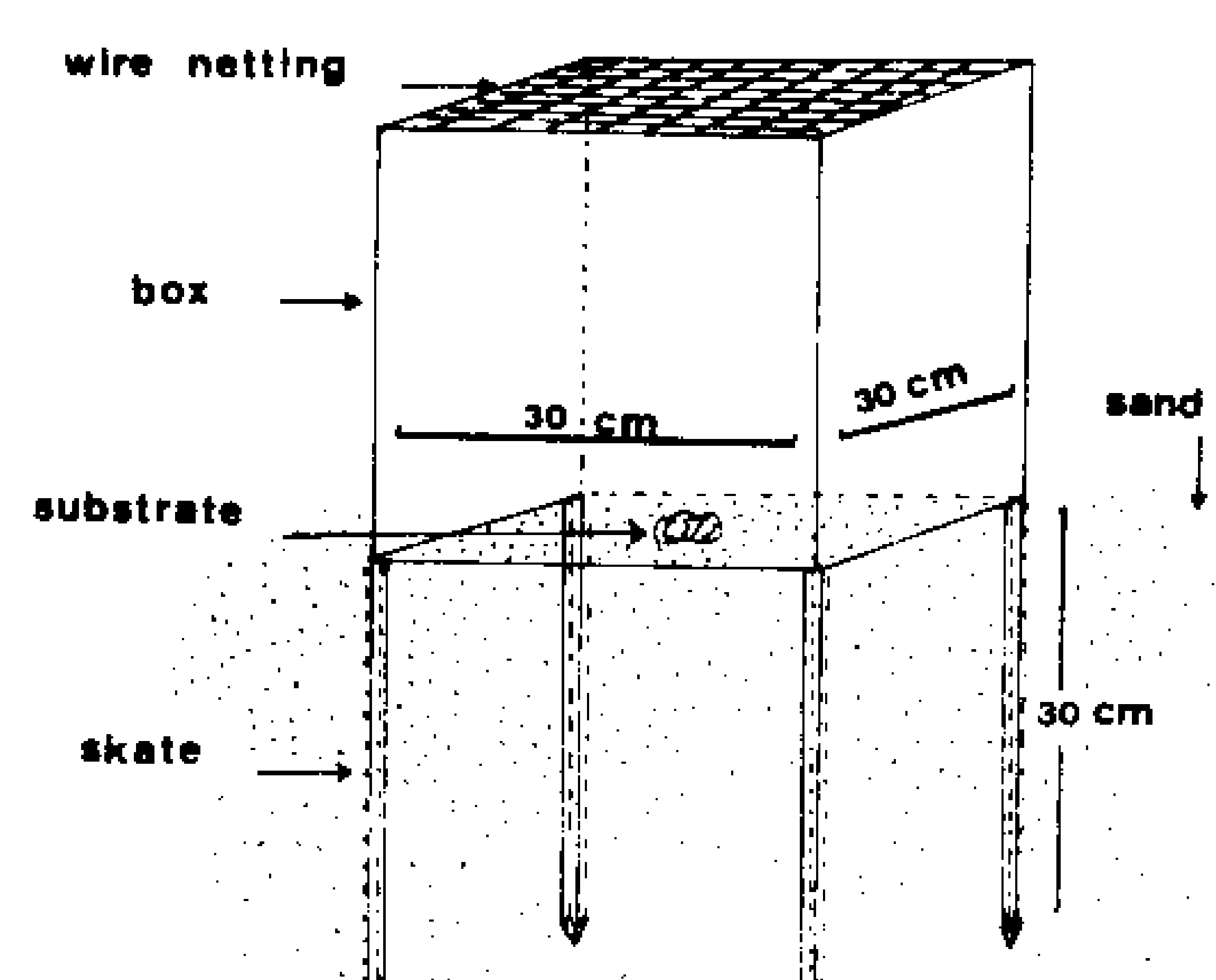

Fig. 3: device to set the breeding boxes directly on the beach sand, containing fish substrate (2nd stage of the work).

Granulometric analysis of the sand using the sieving method was done by the laboratory of granulometry (Institute of Biology – UFRJ). The salinity of the water was measured by the conductivity method, at the Department of Marine Biology (Inst. Biology – UFRJ).

In this part of the experiments, sardines were the only substrate used.

Pupae obtained from the experiment were taken to the laboratory in glass flasks containing sawdust and kept at room temperature ($\bar{X}$ = 24 ± 2 °C) until the emergence of adults.

The whole research begun in April 1989 and lasted for seven months. The breeding related to the first experiment was carried out at the Laboratory of Entomology of the Department of Biology, FIOCRUZ, under direction of Dr Hugo de Souza Lopes.

Statistical analysis using the chi-square test was done.

RESULTS AND DISCUSSION

In the present work 3,652 muscoid dipterans belonging to four Familia were obtained: Sarcophagidae (five species), Muscidae (four species), Calliphoridae (three species), and Faniidae (one specie). The Calliphoridae species were found the most prolific (1,539 specimens – 42.14%), followed by Faniidae (1,094 specimens – 29.95%), Muscidae (546 specimens – 14.95%) and Sarcophagidae (473 specimens – 12.95%).

In a previous work 38.85% of Calliphoridae were found in the rural area (d'Almeida, 1986) and 38.48% of Muscidae in urban area (d'Almeida, 1988). It should be noticed that this urban area was quite near the beach of the present research.

The distribution of the species by the different substrates is given in Table I. It's convenient to keep in mind that quantitative comparisons between the different species obtained may reflect factors like the reproductive capacity of each species and also the limitations imposed by the methodology used.

The substrate preferences are represented in Table II. The most frequent species on the various substrates was *Fannia* sp. (subgroup pusio), represented by 29.95%, what agrees with previous results obtained in an urban area (d'Almeida, 1988) and in the Rio de Janeiro Zoo (d'Almeida, 1989).

Szadziewiski (1983) in Poland caught less adult *Fannia ciliata, F. glauscences* and *F. sociella* in beach areas and salt marshes than in low salinity areas, and classified these species as haloxens due to their preference for these habitats.

Chrysomya megacephala (23.74%) and *Phaenicia eximia* (18.15%) were the most frequent Calliphoridae (Table I). *C. megacephala* has been found the most prevalent species in Rio de Janeiro (d'Almeida & Lopes, 1983) presenting high synantropy (+63,7). Their prefered substrate on beaches was bovine liver, followed by fish (Tables I, II). Similar results were obtained previously in urban and rural areas (d'Almeida, 1986, 1988), although Thomas (1951) and Norris (1965) found preference for feaces.

P. eximia breed at the beach more frequently on mouse carcass (99.09%) similarly to what happens in other areas studied (d'Almeida, 1986, 1988, 1989). Lopes (1973) obtained similar results when using the same substrates in Tijuca Forest, Rio de Janeiro this results suggesting that mouse carcass is the prefered substrate for this species.

Synthesiomyia nudiseta prefered to breed on liver (48.96%) – similar results were found in an urban area and at the Rio de Janeiro Zoo (54.24% and 58.36% respectively), but in rural areas the prefered substrate was fish (d'Almeida, 1986).

On beaches (Tables I and II), *Peckya chrysostoma* was the most frequent Sarcophagidae (10.43%), being squid its prefered substrate (39.63%). Similar results were obtained in the Zoological Garden (d'Almeida, 1989). Both in rural and urban areas, fish and crab were the prefered substrates (d'Almeida, 1986, 1988). Lopes (1973) bred this Sarcophagidae on fish in the Tijuca Forest, the same author (personal communication) found this species frequently on beaches.

Musca domestica, of great sanitary importance, was not abundantly found (Table I), agreeing with previous work (d'Almeida, 1988, 1989). In the rural area it was the most frequently bred muscoid (34.28%), prefering faeces as substrates in all studied habitats (d'Almeida, 1986, 1988, 1989).

Atherigona orientalis this cosmopolitan species was not frequently found, and bred exclusively on tomatoes (Table I). In the pre-

TABLE I

Distribution of species of Caliptrate Diptera, collected in experiment 1 in relation to the employed substrate used

Species	Fish		Mouse		Liver		Crab		Shrimp		Squid		Faeces		Tomato		Banana		Papaya		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Fannia sp. (sub-group pusio)	153	13.98	43	3.93	240	21.93	113	10.32	308	28.15	141	12.88	53	4.84	23	2.10	–	–	20	1.82	1094	29.95
Chrysomya megacephala	190	21.91	164	18.91	208	23.99	108	12.45	139	16.03	58	6.68	–	–	–	–	–	–	–	–	867	23.74
Phaenicia eximia	–	–	657	99.09	–	–	–	–	–	–	–	–	6	0.90	–	–	–	–	–	–	663	18.15
Synthesiomyia nudiseta	12	3.10	57	14.7	189	48.96	–	–	–	–	115	29.79	13	3.36	–	–	–	–	–	–	386	10.56
Peckya chrysostoma	54	14.17	39	10.23	22	5.77	50	13.12	65	17.06	151	39.63	–	–	–	–	–	–	–	–	381	10.43
Musca domestica	–	–	–	–	–	–	8	9.52	–	–	–	–	76	90.47	–	–	–	–	–	–	84	2.30
Atherigona orientalis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	54	100.00	–	–	–	–	54	1.47
Sarcophagula sp.	–	–	–	–	–	–	–	–	–	–	–	–	34	100.00	–	–	–	–	–	–	34	0.93
Ravinia belforti	–	–	–	–	–	–	–	–	–	–	–	–	31	100.00	–	–	–	–	–	–	31	0.84
Ophyra aenescens	–	–	13	59.09	–	–	–	–	–	–	9	40.90	–	–	–	–	–	–	–	–	22	0.60
Sarcodexia innota	6	28.57	–	–	9	42.85	6	28.57	–	–	–	–	–	–	–	–	–	–	–	–	21	0.57
Chrysomya puctoria	–	–	–	–	–	–	–	–	–	–	9	100.00	–	–	–	–	–	–	–	–	9	0.24
Villegasia almeidai	–	–	–	–	–	–	6	100.00	–	–	–	–	–	–	–	–	–	–	–	–	6	9.16
Total	415	11.36	960	26.28	668	18.29	291	7.96	525	14.37	483	13.22	213	5.83	77	2.10	–	–	20	0.54	3652	100.00

TABLE II

Preferences of the most frequent species of caliptrate Diptera in relation to substrates used to attract and breeding. Decreasing order from left to right. No significant differences (α = 0,05%) are marked by an horizontal line (50 or more individuals computed on each substrate)

Fannia sp. (sub-group pusio)	shrimp	liver	fish	squid	crab	feaces	mouse	tomato	papaya
Chrysomya megacephala	liver	fish	mouse	shrimp	crab	squid			
Phaenicia eximia	mouse	feaces							
Synthesiomyia nudiseta	liver	squid	mouse	faeces	fish				
Peckya chrysostoma	squid	shrimp	fish	crab	mouse	liver			
Musca domestica	faeces	crab							
Atherigona orientalis	tomato								

vious work (d'Almeida, 1988) it was found to breed better on decaying fruits. Bohart & Gressit (1951) said that *A. orientalis* may grow on a great variety of substrates ranging from animal carcass, decomposing fruit, vegetables and faeces. Linhares (1979), d'Almeida (1983) observed attraction of this species to various substances but showed its preference for breeding in decomposing fruit (d'Almeida, 1986, 1988, 1989).

No consideration will be made on the other flies, except for *Villegasia almeida* found frequently on beaches by Lopes (personal communication). This author suggested further studies on this species, due to its constant presence on beaches and its unknown biology.

At the second phase of the research, pupae were recovered straight from the sand (Table III). From 189 pupae recovered only 6 adults hatched (32.81%). *P. chrysostoma* was the most frequent species (58.06%) followed by *C. megacephala* (30.64%). The granulometric sand analysis revealed 2 sizes of granules: fine sand ($\bar{X}$ = 0,183 mm) at the superficial level up to 10 cm, and fine sand ($\bar{X}$ = 0,222 mm) at deep level under 10 cm.

TABLE III

Totals and distribution of species of caliptrate Diptera emerged from pupae recovered from the fish baits placed on the beach sand

	No.	%
Total of pupae obtained	189	100.00
Total of pupae lost	127	67.19
Total of pupae emerged	62	32.81
Peckya chrysostoma	36	58.06
Chrysomya megacephala	19	30.64
Synthesiomyia nudiseta	6	9.67
Phaenicia eximia	1	1.61

The majority of pupae (70%) were collected from the superficial level.

The conductivity test revealed low degrees of water salinity 20.2% (normal is 30.1%).

The results obtained certainly were influenced by granulometric characteristics of the sand and the low salinity of the water in the studied area, when *C. megacephala* and *P. chrysostoma* were considered. It might be suggested that they showed capacity of colonizing on beaches. Esser (1990) studying the oviposition and larval development of *C. megacephala* in salted and dried fishes, observed that this Calliphoridae species resists and develop better in fish with low saline concentrations, diminishing this resistence proportionaly to the increase of salinity.

Arcanjo Leal et al. (1987) working on beaches of Pernambuco, found that the Familia Sarcophagidae was the more frequent (41.3%) of the flies, followed by the Familia Ephydridae. *Helicobia, Sarcophagula* and *Sarothromyia* were the most abundant genera of the first Familia. However, in the present work, only *Sarcophaghula* was found breeding with the employed substrates. According to Hall (1932), the adults of *Sarothromyia femoralis,* besides of being frequent, are difficult to collect on beaches. The absence of these flies so characteristic of beaches, on the offered substrates suggests that they may breed only in the intermediate zone, where competition with other species is less frequent.

Another interesting species is *S. nudiseta* which presents a cocoon involving the pupae, who might improve the breeding chances of this species in these ecosystems.

A number of factors limits the colonization of caliptrate Diptera on beaches: tide movement, periodic floods, constant wind, salinity, granularity and large day/night temperature variation. Accordingly to Steinly (1986) these factors, added of the competition with crustaceans limit the colonization of insects in marine habitats. Hinton (1976) suggests that the movement of tides associated to regular floods and the drying out of the sand limits the colonization to the intermediate zones.

As showed some muscoids that reach the beach areas (phase I) may breed in artificial conditions, but only few resist when conditions come close to the natural (phase II).

It is also important to state the high polution and ambiental degradation affecting the swamp area near the selected beach. The most resistent species, like the synantropic ones, could have been selected, excluding those which were originally part of the natural fauna of the area.

The results obtained suggest further studies, including laboratory observations to elucidate some points which are not very clear, as further substrate preference; reproductive capacity of the most frequent species, larval development on different substrates and also comparative field work on population free beaches.

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