BIONOMICS OF FLIES
(DIPTERA : CALLIPHORIDAE, SARCOPHAGIDAE AND MUSCIDAE)
OF JALPAIGURI DISTRICT, WEST BENGAL

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S Y N O P S I S

Occurrence and distribution of flies (Calliphoridae, Muscidae and Sarcophagidae) have been studied at 28 different places of Jalpaiguri District, West Bengal, by using fish-baited traps. It is observed that Calliphorid, Muscid and Sarcophagid flies are more or less uniformly distributed throughout the District, but their relative abundance varies in different localities. Within the District the population of Hemipyrellia ligurriens, Musca lucens, Parasarcophaga ruficornis, and Parasarcophaga albiceps increases towards north but decreases towards south, while the population of Musca pattoni, Musca domestica and Parasarcophaga brevicornis decreases towards north but increases towards south. It is also found that Chrysomya megacephala, Hemipyrellia ligurriens, Parasarcophaga knabi, Parasarcophaga brevicornis, Parasarcophaga albiceps, Parasarcophaga orchidea, Parasarcophaga hirtipes and Boettcheriesa peregrina are more abundant in the northern latitudes than in southern latitudes of the State of West Bengal, though the population of Chrysomya rufifacies was less abundant in the northern parts than in the southern parts of the State.

Chrysomya megacephala and Chrysomya rufifacies are the dominant flies in the markets, while Hemipyrellia ligurriens dominates the catch in garbage dump of Jalpaiguri Town.

Altitudinal distribution of flies reveal that the abundance of all flies are much greater between 25 to 35m than on the ground level. Sarcophagid flies are caught in the traps at 50m, though Calliphorid and Muscid flies do not occur at that altitude.

Calliphorid and Muscid flies exhibit bimodal peaks while Sarcophagid flies show unimodal peak in their annual population curve. The number of generations produced by a species in a year varies from species to species and the density of population of a species not only depends on the number of generations produced in a year but also on eco-climatic factors of the study area. Population of Calliphorid and Muscid flies increasesin summer while that of Sarcophagids increasesin spring. The noxious species of the study area are Chrysomya megacephala, Chrysomya rufifacies, Hemipyrellia liturriens, Musca domestica, Ophyra chalcogaster, Parasarcophaga brevicornis, Parasarcophaga albiceps and Parasarcophaga knabi.

Studies on the photophilic behaviour of flies reveal that most of the species are either heliophilic or ext scoto-philic, but there is another group of flies (including Musca domestica, Musca sorbens and Parasarcophaga albiceps) which are equally available in the sun as well as in the shade.

Flies in general are attracted to fish-bait than to any other animal bait. Calliphorid and Sarcophagid flies show preference to proteinaceous baits more than the Muscids.

Chrysomya megacephala, Chrysomya rufifacies, Musca domestica, Musca sorbens and Musca lucens exhibit bimodal dial periodicity curve in May and in early September but their activity curves become unimodal in late September. Calliphorids and Muscids are active throughout the day-light period, but the activity of Chrysomya megacephala and Chrysomya rufifacies diminish in and around noon hours when their ambient temperature rises above their thermal preferendum level. The inactivity of Muscid flies in the same hours is due to rainfall or due to rise of atmospheric temperature beyond the level of their thermal preferendum. Under experimental conditions Chrysomya megacephala, Musca domestica, Musca sorbens and Musca lucens are found to exhibit bimodal feeding and mating activity curves while those flies exhibit unimodal curves of activity in respect of oviposition and pupal emergence.

Hemipyrellia ligurriens, Hemipyrellia pulchra, Chrysomya megacephala and Musca domestica exhibit greater degree of domestication, while higher danger indices were recorded in cases of Hemipyrellia ligurriens, Parasarcophaga misera, Parasarcophaga ruficornis, Boettcherisca peregrina, Hemipyrellia pulchra, Parasarcophaga knabi and Parasarcophaga albiceps.

It is concluded that the dangerousness of a fly species depends not only on the degree of its dangerousness or danger index but also on its abundance.

F O R E W O R D

Flies visit every home in all parts of the world and they are the closest arthropod neighbours of mankind. Flies act as carriers of pathogenic organisms on account of their habit of visiting all kinds of exposed food material, as well as faeces and other filthy substances. The larvae of flies also cause myiasis in man and domesticated animals. Myiasis in animals often leads to death, thus causing huge economic loss.

Eradication of harmful flies is a problem for every civilised society. Detailed information regarding bionomics of these important flies is sadly lacking in our country. Keeping this lacuna in view Dr. P. Roy, of the Department of Zoology, Siliguri College, Siliguri, India (1973) and Dr. S. Das, of the Department of Zoology, Chandannagare College, Hooghly, India (1980), studied various aspects of bionomics of these important flies in Siliguri and in Calcutta.

The present work has been undertaken as an extension of the above studies in order to obtain a clear knowledge of the Spatial distribution, Composition of population in garbage dump, slaughter house and market areas, altitudinal distribution, seasonal occurrence, photophilic nature, behaviour towards various attractants, diurnal activity and activities

under experimental conditions (*viz.*, feeding, mating, oviposition and pupal emergence), degree of domestication and relative dangerousness of these flies in Jalpaiguri District, West Bengal, India.

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Chapter - I

SPATIAL DISTRIBUTION OF FLIES

INTRODUCTION

Sarcosaprophagous flies belonging to the families Calliphoridae, Muscidae and Sarcophagidae are important from the point of view of Public Health and Hygiene in different parts of the world.

Work on these flies have been carried out by various workers in different parts of the world, and many species and genera of these flies are known to occur in diverse habitat.

These flies have also received attention of investigators in the Indian sub-continent, and work on Indian Calliphorid and Sarcophagid flies was compiled by Senior White et al., (1940). The distribution in the Indian sub-continent of Calliphorid (after Senior White et al., 1940; and James, 1977) and Sarcophagid (after Senior White et al., 1940; and Lopes et al., 1977) flies covered in the present study is given in Appendices I and II.

Work on Indian Muscidae was originally compiled by Van Emden and revised by Seymour-Sewell and Rozwal (1965). Distribution of these flies in Indian sub-continent (after van Emden, 1965; and Pont, 1977) is also very intensive and a summary is given in Appendix III.

After the above monumental work by Senior White et al.,(1940) and van Emden (1965) the next worker in this field in Indian sub-continent was Nandi (1976a,b; 1977a,b and 1978), whose report on genera and species of Sarcophagid flies from

Indian sub-continent (with special emphasis to West Bengal State) is summarised in Appendix IV.

It will be seen from Appendix IV that Nandi could find 11 species belonging to 6 genera of Sarcophagid flies from the District of Jalpaiguri alone. The specimens obtained by him were collected in three different rural areas (Chalsa, Jainti and Madarihat) of the District, while three other areas from where the species were collected were forest land (Chilapata, Garumara and Rajabhatkhowa). One of the above forest land was situated on high ground (Jainti, altitude 179.5m). The distribution of these flies in Jalpaiguri District, as reported by Nandi (1977c) is summarised in Appendix V.

The present study was undertaken in order to obtain a more comprehensive idea about the distribution of flies belonging to families Calliphoridae, Muscidae and Sarcophagidae in Jalpaiguri District which comprises of an area of 6245 sq.km forming a parallelogram with a length of 139.60 km from east to west, and a breadth of 61.15 km from north to south, approximately, and lying between 26°13' and 27°0'N latitude and between 88°30' and 89°55'E longitude.

The District is situated near the boundary line between the Oriental and Palaearctic Realms and the terrain consists of high lands, hillocks and plain fields through which run a number of rivers and streams. These rivers and streams come down into

the Gangetic plain cutting across forests and fertile fields, skirting different townships, villages and hamlets inhabited by diverse tribal and plains people. Because of the above diversity the District provides a varied habitat for the Sarcosaprophagous flies which are found to thrive in habited as well as in un-inhabited places of the District.

The present study was undertaken to survey the occurrence of the above flies in the different areas of the District. For the purpose of this study collections were made in urban, rural and forest areas. Variations in the distribution of fly fauna from north latitudes to south were reported from some other countries (Schoof and Savage, 1955; Gregor and Povolny, 1964; Power and Melnick, 1945; Melnick et al., 1947; Hall, 1948; Schoof et al., 1956; Nuorteva and Laurikainen, 1964). In the course of the present study variations in distribution from northern to southern areas of the District, as well as variations from eastern to western regions of the District could be ascertained.

In addition to the above study particular attention was also given to the occurrence of these flies in the garbage dump, slaughter house and the market areas of the main urban centre of the District i.e., Jalpaiguri Town. Similar work was reported by Aradi and Mihalyi (1971) from Budapest, who studied fly fauna from market areas, and by Nuorteva (1966b) who studied

fly fauna from refuse depot of Kuopio city, Finland.

Side by side, a study was also undertaken on the altitudinal distribution of these flies in an urban area and in a rural area both situated in the plains, upto a height of 100m from the ground level. For this purpose the traps were placed at different heights of the Microwave Tower of the Telecommunications Department, Govt. of India, and also on the roof top of residential buildings of different heights.

Similarly, a study of altitudinal distribution of flies was made by the use of baloon in Europe (Nuorteva, 1964). In Japan the distribution of flies was studied at different altitudes on Mount Fuji (Shinonaga, 1965).

A brief account of Jalpaiguri District and trapping areas in the District :-

The following is a brief description of Jalpaiguri District which provides the habitat for the sarcosaprophagous flies reported in the present study.

The District of Jalpaiguri is bounded by Darjeeling District (India) and Bhutan on the north, the Sankosh river and Goalpara District of Assam (India) on the east, Coochbehar District (India) and Bangladesh on the south and Darjeeling District (India) and Bangladesh on the west.

The average annual rainfall in the District is about 317 cm. There is pre-monsoon shower during February and March,

but over 70% of rainfall is precipitated during June to September. Wet summer with high rainfall and humidity and prolonged dry to semi-dry winter is the characteristic climate of the District. The rainfall of Jalpaiguri Town is heavier than in Darjeeling and the rainfall increases in the north of the Western Duars.* Western Duars area is in the east of Jalpaiguri Town and occupies that part of the District which lies between

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*Duars meaning Doors to the mountains - is actually an area included in the Terai. The running strip of plain land, 24 km. to 34 km. wide, along the entire length of the foot-hills of the Himalayas from west to east is known as Terai(This is a Persian word meaning a damp and humid place). A cross-section, north to south, across Sikkim would resemble a gigantic staircase running step by step down from the high Tibetan plateau to the Gangetic plain and the Terai would form the initial ascending step.

Western Duars is a flat level strip of country averaging about35 km in width, running first along the foot of the Kalimpong Hills and then along the Bhutan Hills. There are supposed to be eleven Duars or passes into Bhutan from India, of which five are located in Jalpaiguri District.

The general elevation of Terai and Duars is over 76 m with a general southernly slope of 5 to 8 cm per km. The climate of Terai and Duars is characterised by heat, humidity and heavy

Tista and Sankosh rivers. The chief characteristics of western Duars are the numerous rivers and hill streams which intersect the area in diverse directions. The country west of Tista presents a slightly undulating expanse of level paddy fields and scrub jungle. In the northern part of the Duars the altitude varies between 61 m to 609 m, while the altitude in the north of the Duars, roughly along 89°40'E, reaches as high as 914 m. General topography is undulating from north to south, and gradually sloping down towards south.

The soil texture of the District is generally sandy to sandy loam and has low moisture retaining capacity. The nature of soil is acidic (4.5 to 6.5 pH), and the acidity of the soil, decreases towards the remote corner of Duars.

Originating from the Himalayan ranges in the north the rivers (Tista, Lish, Ghish, Chel, Murti, Jaldhaka, Diana, Torsa, Kaljani, Raidak and Sankosh etc), which are characterised by high current and shallow depth, flow through the District. These are often in spate due to high precipitation within a short period in the catchment areas and vast tracts of lands on both banks of their course are often flooded. Agricultural tracts of land are thus damaged both by inundation and sand deposition or by erosion.

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precipitation.

Duars in Jalpaiguri is actually the western part of Duars beyond Sankosh river.

Four forest divisions and a large number of tea gardens occoupy approximately a land area of 25% and 20% respectively. All the forest divisions - Jalpaiguri, Coochbehar, Baikunthapur and Buxa are moist tropical forests rich in flora and fauna. Three reserve forests (Garumara, Chapramari and Jaldapara) including sanctuaries for wild animals are also situated within the above forest divisions. The forests abound with Sal (Shorea robusta) and other economically important species of trees including Schina wallichii, Michelia champaca, Chukrasia tabularis, Dalbergia sissoo, Amoora wallichii etc.

The tea industry flourishes on account of soil of western Duars, which is 9 cm to 10 cm deep with a substratum of gravel and shingle, containing the valuable red top soil.

Total population of the District is 1,750,159 (rural 1,582,090 and urban 168,080) with the average population density of 280/sq.km. The District compriese of two sub-divisions (Jalpaiguri and Alipurduar), thirteen police stations, eight towns and 754 villages. In Jalpaiguri, the number of Scheduled Tribe population is the largest among all the Districts of West Bengal. There are altogether about 20 such tribes including Mech, Rabha, Garo and Toto. Most of the tribals are concentrated in Alipurduar Sub-division while in Sadar Sub-division a sizable number of tribal people are settled in the tea gardens of Dhubguri, Malbaza and Nagrakata police stations. The labourers in the tea plantation

also include a large number of tribals who came from Chotanagpur and adjoining areas of Bihar State. Medico-Public health facilities of this educationally backward District is not sufficient to cope with any sudden out-break of epidemic diseases especially in the rural areas.

The general sanitation of urban areas of the District is poor and no scientific sanitation is practised in the rural areas. Influx of refugees from Bangladesh who have settled in unhealthy private colonies in different parts of the District have further aggravated the deteriorating arrangements for sanitation. In the vast majority of tea gardens the sanitary conditions are also poor.

Economy of the District is based on agricultural produce, animal husbandary, fishery, sericulture, forest produce and pine-apple plantations.

The following are the localities where trapping of flies was undertaken :-

Urban areas :

Locality number 1.

Alipurduar (26°29'N and 89°32'E):

Municipal area 9.29 sq.km.: Altitude 142 m : Population density 133/sq.km.

This is the Sub-divisional headquarters of the same name and is inhabited by Kheria and Lodha, Munda, Mahali, Mech,

Nagesia, Oraon, Rabha and Santal tribes and refugees from Bangladesh. The town is surrounded by Buxa reserve forest and tea gardens. During rains which last from May to September the town is frequently flooded and Malaria is very much prevalent. The place is well-connected by rail and good roads with Jalpaiguri Town situated at a distance of about 136 km.

Trap was placed behind an eating house in front of a big m open drain near Alipurduar railway station.

Locality No. 2.

Dhubguri (26°36'N and 89°1'E):

Area 14.55 sq.m.: Altitude 91 m : Population 16808.

This is a well-populated urban area about 39 km to the north-east of Jalpaiguri Town. The place is inhabited by Kheria and Lodha, Malpaharia, Munda, Mahali, Oraon, Rabha and Santal tribes and by refugees from Bangladesh. The place is famous for jute trading market and is situated in the centre of a fertile tract of rice-growing country, well-connected by roads and rail-line with the rest of the District. The town is one of the unhealthiest stations in the western Duars and lacks in scientific drainage and sanitation arrangements.

Trap was placed inside the market by the side of fish-stall.

Locality No. 3.

Falakata (26°31'N and 89°15'E):

Area 4.92 sq.m. : Altitude 64 m. : Population 7194.

It is an urban area on the east bank of Mujnai river close to the Cooohbehar District boundary, 89 km to the north-east of Jalpaiguri Town. Falakata is a non-municipal town and is inhabited mostly by refugees from Bangladeeh. The outlying areas are inhabited by Kora, Kheria and Lodha, Munda, Mahali, Oraon and Santhal Tribes. Falakata is an important market place in the middle of rice-growing area of the District and is connected by good roads and railways. Scientific drainage system is lacking resulting in stagnation of water near each and every dwelling house.

Trap was placed in the middle of a play-ground inside the school premises adjacent to the market.

Locality No. 4.

Jalpaiguri Town (26°15'N and 88°45'E):

Municipal area 10.08 sq.km. : Altitude 90 m : Population 280/sq.km.

This town is the Divisional headquarters of five North Bengal Districts and is the most thickly populated town in Duars area. River Tista flows all along the south-eastern periphery of the town. River Karolla flowing from north-western side towards Tista, traverses the town, roughly dividing it into a

smaller north-eastern and a bigger south-western block. The south-western block of the town is much more thickly populated than the north-eastern part. Railway station, Fire station, Women's College, Teachers' training college and Commerce College are situated in the south-western block. Hospital and Court are situated in the north-eastern block, on the bank of Rivers Karolla and Tista respectively. The town is well-connected by good roads and railways with the other parts of the District.

Sanitation of the town is not satisfactory because of old and open drains, service latrines, marshy lands and refuse dumps. Sanitary condition deteriorates further during rains, when drains clogged with refuse of adjacent houses, overflow and submerge a large area of the town creating favourable conditions for fly breeding.

Trap was placed inside the compound of Fire Brigade station which is situated in a well-populated residential area of the town.

Locality No. 5.

Malbasar (26°53'N and 88°45'E):

Area 2.56 sq.km. : Altitude 137 m : Population 10951.

It is a small non-municipal town about 66 km to the north of Jalpaiguri Town and is well-connected by good roads and railways with the other parts of the District. Malbasar is surrounded by tea gardens on all sides and has High Schools,

daily markets and Hospital. Inhabitants include Chakma, Garo, Ho, Hajang, Kora, Kheria and Lodha, Malpahariya, Mahali, Meech, Mru tribes and refugees from Bangladesh. Medico-Public health facilities are very poor. Uncleaned open drains with stagnant water, service latrines and privy pits are common.

Trap was placed in an open area inside the market by the side of fish-stall.

Locality No. 6.

Maynaguri (26°38′ and 88°50′E):

Area 12.38 sq.m. : Altitude 84.14 m : Population-15808.

It is a small non-municipal town, 20 km to the north-east of Jalpaiguri Town and is well-connected by good roads and railways with the other parts of the District. There are Health Centre, High Schools and markets. Chief inhabitants include Kora and Santhal tribes, Rajbanshese and refugees from Bangladesh. Cultivable lands, ponds, ditches and marshy land are found in and around the town. Scientific sanitation system does not exist.

Trap was placed in an open field adjacent to market area.

Rural areas :-

Locality No. 7.

Bagrakote (26°52'N and 88°34'E):

Area 18.52 hectare : Altitude 183 m : Population 43.

This is a very thinly populated rural area about 100 km on the north-western side of Jalpaiguri Town with which it is connected by railway line and by road. This foot-hill village is situated on the bank of Chish river and is very close to border of Darjeeling District. The place is inhabited by only a few railway employees and is surrounded by tea gardens and a coal-field is nearby. The climate of the area is cooler than in Jalpaiguri Town. Scientific sanitation is lacking.

Trap was placed near the railway station by the side of a road and in front of a tea-stall.

Locality No. 8.

Bhelakoba (26°35'N and 88°36'E):

Area 2500.46 hectare : Altitude 92 m : Population 8931.

This is a large village surrounded by forest and tea gardens, and is situated 20 km on the north-western side of Jalpaiguri Town. This village is well-populated by Rajbanshees (a Scheduled Caste people) and refugees from Bangladesh. Bhelakoba is an important business centre having High Schools, market and Hospital and is well-connected with the Jalpaiguri Town on the one hand and with Siliguri (Darjeeling District) on the other.

During rains stagnation of water takes place in low-lying areas and the overflowing open drains create a favourable condition for fly breeding. Service latrines and privy pits are common.

Trap was placed at the centre of a field close to market area which is never cleaned and is in unhealthy surroundings.

Locality No. 9.

Berubari (26°28'N and 88°42'E):

Area 33.55 hectare : Altitude 60.30m : Population 654.

It is a thinly populated village mostly inhabited by refugees from Bangladesh. The place is 16 km to the south of Jalpaiguri Town and is situated on the bank of river Ranga. Bangladesh border is 2 km on the north-west of Berubari which is connected by a good road with Jalpaiguri Town. The village is surrounded by agricultural fields and the main occupation of the villagers is cultivation. Sanitary arrangements are very poor.

Trap was placed inside an marketting enclosure where villagers come for marketing once a week. There are some thatched houses and trees nearby.

Locality No. 10.

Birpara (26°43'N and 89°8'E):

Area 26047.49 hectare : Altitude 118 m : Population-11850.

This is a village in the western Duars situated within the tea garden of the same name and is at a distance of 65 km to the north-east of Jalpaiguri Town. Birpara is an important business centre having High Schools and market, and is well-connected by roads and railways with the rest of the District. This well-populated village is mostly inhabited by Santhal and Oraon tribes and by refugees from Bangladesh. Medico-Public health facilities are poor. Uncleared open drains with stagnant water, service latrines and privy pits are common.

Trap was placed in an open field by the side of a whole-sale fish market near the railway colony.

Locality No. 11.

Chalsa (26°52'N and 88°48'E):

Area 298.41 hectare : Altitude 157 m : Population 2071.

This is a thinly populated village in the western Duars, and is about 58 km to the north-east of Jalpaiguri Town. This village is surrounded by forest and tea gardens and is situated at the base of a hillock. It is well-connected by railways and roads, but lacks scientific drainage and sanitary system.

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Trap was placed 50 m away from the National Highway (NH-31) which passes through the village.

Locality No. 12.

Fatapukur (26°33'N and 88°32'E):

Area 1056.00 sq.km.: Altitude 97.5 m : Population-5218.

This thinly populated village in the Rajganj police station is situated by the side of the road connecting Siliguri City and Jalpaiguri Town. The village is surrounded by agricultural lands, marshy lands, ponds and ditches. Refugees from Bangladesh, and Munda, Oraon and Santhal tribes are settled here in separate colonies where hygienic conditions are poor.

Trap was placed in an open land by the side of some thatched houses of the village.

Locality No. 13.

Gairkata (26°43'N and 89°1'E):

Area 296.34 hectare: Altitude 102 m: Population 4479.

This is a thickly populated village and is situated about 52 km to the north-east of Jalpaiguri Town on the bank of Angrabasha which is a tributary of Dudua river. The village has a large market, and a High School and is well-connected with rice producing country in the south and with tea gardens in the north. Total population of the village is predominently Rajbanshese, a Scheduled Caste people of the District. Drainage system

and sanitation is poorly developed and scattered ponds, ditches and open privy pits are common.

Trap was placed near the market.

Locality No. 14.

Hamiltanganj (26°40'N and 89°26'E):

Area 301.29 hectare: Altitude 65.5 m : Population 2050.

It is a sparsely populated village, about 100 km to the north-east of Jalpaiguri Town and is surrounded by tea gardens on all sides. The population of this village and its police station (Kalchini) area chiefly consists of Bhutias including Toto etc., Kheria and Lodha, Munda, Mahali, Mech, Nageria, Oraon, Rabha and Santhal tribes and some refugees from Bangladesh. Drainage and sanitary system are yet to be developed.

The trapping was made near the market area.

Locality No. 15.

Jalpesh (26°31'N and 88°52'E):

Area 215.15 hec. : Altitude 76.82 m : Population 1628

This is a densely populated village about 27 km to the east of Jalpaiguri Town. This village is famous for its Lord 'Shiva' Temple which attracts thousands of pilgrims in the month of February and March. The village is surrounded by

agricultural field on all sides. There is a High School and a market place and is chiefly inhabited by Rajbanshese (a Scheduled Caste people).

Trapping was made inside the compound of a residential house close to the ground where fair is held annually.

Locality No. 16.

Jaygaon (26°50'N and 89°23'E):

Area 337.79 hectare: Altitude 219.5 m : Population-2042.

It is a small village situated just on the Indo-Bhutanese border about 112 km to the north-east of Jalpaiguri Town. The nearest Bhutanese Town, Phuntsholing is about 0.5 km to the north of the village. The inhabitants are mostly Rajbanshese families. Stagnation of water even during rains is not a problem as the place is situated on the slope of a hillock.

Trapping was made by the side of the main road a few yards inside Bhutanese territory adjoining Phuntsholing.

Locality No. 17.

Kamakhyaguri (26°27'N and 89°43'E):

Area 350.81 hectare: Altitude 41m : Population 6026.

It is a thickly populated village situated 157 km to the east of Jalpaiguri Town close to Coochbehar District border on the south and Bhalka reserved forest in the north. Cultivable

land, marshy land and open meadows surround the village which has a High School and the place is inhabited by refugees from Bangladesh. River Raidak rivers flows in the east of the village flooding the area during rains. Open privy pits are common and sanitation and drainage system is absolutely lacking.

Trapping was made near the market area.

Locality No. 18.

Kumargram (26°42'N and 89°48'E):

Area 549.70 hectare : Altitude 76.21 m : Population-2848.

It is a large village about 185 km to the north-east of Jalpaiguri Town, not far from the Assam border in the east, and Jhumka and Bhalka reserve forests on the north and on the south of the village respectively. The village is connected by roads to Alipurduar and Coochbehar Town and has a High School and a market. Ponds, ditches and marshy lands are found in and around the village where sanitation conditions worsen during rains in the absence of a proper drainage system. This police station area including the village of the same name is inhabited by Scheduled Tribes (Kheria and Lodha, Munda, Mahali, Mech, Oraon, Rabha and Santhal), and refugees from Bangladesh.

Trap was placed in an open field close to the village Post Office.

Locality No. 19.

Madarihat (26°41'N and 89°17'E):

Area 429.41 hectare: Altitude 98 m: Population 1032.

It is a thinly populated village and is situated about 81 km to the north-east of Jalpaiguri Town, on the west bank of river Torsa and is well-connected by roads and railways with the other parts of the District. Jaldapara and Torsa reserve forest is in the south-eastern end of the village. Famous Jaldapara Wild Life Sanctuary (inhabited by Rhinoceros unicornis, Bos gaurus, Elephas maximus, Axis axis, Axis porcinus, Panthera tigris tigris, Wild pig* etc.) is about 4 km in the south. Sanitation and drainage systems are lacking. This village has a High School, a market place and a Health Centre. Inhabitants include Kheria, Lodha, Malpahariya, Munda, Mahali, Mech, Oraon, Rabha, Santhal, Bhutia including Toto tribes etc and refugees from Bangladesh.

Trap was placed inside an enclosure where villagers come for marketing once a week.

Locality No. 20.

Manikganj (26°16'N and 88°47'E):

Area 106 hec. : Altitude 66m : Population 1253

This is a small village about 29 km to the south of Jalpaiguri Town, surrounded by Bangladesh territory on all the

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*Sus salvanius ( ) .

three sides. Bangladesh border is a few minutes' walk towards the eastern side of the village. Cultivable land, marshy land and open meadows surround the village which has a Junior High School. The place is chiefly inhabited by refugees from Bangladesh and Rajbanshese. Sanitation and drainage systems do not exist.

Trapping was made in an enclosure adjacent to a fish-stall where villagers come for marketting once a week.

Locality No. 21.

Matelli (26°33'N and 88°48'E):

Area 31.17 hectare : Altitude 282 m : Population-3010.

This village is on a hillock situated at a distance of 64 km to the north of Jalpaiguri Town and is well-connected by railways and roadways with the other parts of the district. The village has a High School, a Post Office and has an important market place which cater to the needs of the surrounding tea gardens. The inhabitants of this area are Bhumig, Kheria and Lodha, Munda, Mahali, Oraon, Santhal tribes, Rajbanshese and Nepalese. Sanitation system is not developed and scattered privy pits are common.

Trapping was made in an open field in front of the High School.

Locality No. 22.

Nagrakata (26°53'N and 88°56'E):

Area 69.25 hectare: Altitude 177.4 m: Population 331.

It is a large village on the bank of Jaldhaka river situated at the foot-hill zone and is about 72 km to the north-east of Jalpaiguri Town. This village has High School, Post-Office, Health Centre, Private Hospital and a number of tea-garden offices. Chief inhabitants include Kheria and Lodha, Malpahariya, Munda, Mahali, Oraon and Santhal tribes and Rajbanshees. The area is surrounded by a number of m tea garden in the north-east, cultivated lands in the south and river Jaldhaka in the western side. Uncleared drains with stagnant water, service latrines, privy pits and accumulated rain water in low-lying areashas created favourable condition for fly breeding.

Trap was placed in an open field behind the railway station.

Locality No. 23.

Odlabari (26°52'N and 88°38'E):

Area 927.68 hectare: Altitude 160 m : Population 4773.

It is a village in the western Duars about 81 km to the north-west of Jalpaiguri Town, has a High School and an important market place. This village is surrounded by cultiveble lands and marshy lands and is inhabited by Santhal tribe,

Nepalese, Rajbanshese and refugees from Bangladesh. Sanitation and drainage systems do not exist. Ghish and Chel rivers flow respectively on the west and on the east of the village. There are good railway and road connections.

Trap was placed in an open field behind of Railway station adjacent to market area.

Locality No. 24.

Silbarihat (26°31'N and 89°18'E):

Area 610.23 hectare: Altitude 62 m : Population 2665.

A thinly populated village on the right bank of Sil Torsa river, approximately 96 km to the south-east of Jalpaiguri Town and is connected with the other parts of the District by fair-weather roads. Chief inhabitants of this village are refugees from Bangladesh and Rajbanshese. Sanitation and drainage systems do not exist.

The trap was placed inside an enclosure where villagers come for marketting once a week.

Rural areas within the dense forest :-

Locality No. 25.

Jainti (26°42'N and 89°35'E):

Area 1050 hec. : Altitude 179.5 m : Population 1218

This is a thinly populated village on a hillock at a distance of 124 km to the north-east of Jalpaiguri Town and is

surronded by Buxa forest on all sides. This village is very close to Bhutan border and is well-connected by road and railways with Assam State and with the rest of Jalpaiguri District. The inhabitants of this village are mostly Bhutanese, Santhal, Oraons etc. Dolomite and lime-stone mines are situated close to the village.

Trapping was made on the fringe of the dense forest not far from the station yard.

Locality No. 26.

Lankapara (26°47'N and 89°15'E):

Area 9.53 hectare : Altitude 168 m : Population 451.

It is a very small village situated too close to Bhutan border, and is in the midst of Titi forest range about 83 km to the north of Jalpaiguri Town. River Raidak flows on the eastern side of the village. The place is inhabited by Nepalese, Bhutenese and Santhal tribes and sanitary conditions are lacking.

Trap was placed in front of a wooden hut by the side of a mud road.

Locality No. 27.

Lataguri (26°45'N and 88°45'E):

Area 269.84 hectare: Altitude 99.08 m : Population-3287.

It is a village situated in the middle of the Ramsi forest range, 37 km to the north of Jalpaiguri Town. The famous Garumara Wild Life Sanctuary (inhabited by Rhinoceros unicornis, Bos gaurus gaurus, Elephas maximus, Wild pig* etc.) is 10 km away in the north. The village is connected by railways and road with the township of Malbazar of the north, and with the township of Domohani in the south. The inhabitants of the village includs Rajbanshees, Santhal tribe and some refugee from Bangladesh and the main occupation of the inhabitants is connected with timber and firewood business. The village has a High School, a Post Office, a market and saw mills. No drainage system is found and privy pits are common.

Trap was placed in the centre of an enclosure where villagers come for marketting once a week.

Uninhabited dense forest :-

Locality No. 28.

Khuttimari (26°42'N and 88°58'E):

Area undemarketed: Altitude 108m : Population - Nil.

It is an area within Moraghat reserve forest block about 58 km to the north-east of Jalpaiguri Town. A metalled road connecting Nathua with Gairkata passes through this place.

Trap was placed in a very small clearing of the dense forest which abounds in decomposing vegetation and undergrowth.

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*Sus salvanius.

Nearest village Gairkata is situated at a distance of over 5 km to the east of the trapping area.

MATERIAL AND METHOD

(A) Regional distribution of flies :

Trappings were made with fish-baited traps in Jalpaiguri City as well as in 27 other urban, rural and forest areas with varying physical conditions using a type of trap described by Nuorteva (1959). Trappings were undertaken in the months of May and September, when the flies showed their highest abundance. The trapped specimens were collected and identified in the laboratory of Zoology Department, Siliguri College, Siliguri. Identification was carried out with the help of specimens sent by Professor R. Kano, Department of Medical Zoology, Tokyo Medical and Dental University, Tokyo, who kindly sent a set of mounted genitalia along with identified specimens for the purpose. After identification the results were carefully evaluated.

Sample trappings, lasting for a period of ten hours on the average, were made in all the localities using caged trap (described in Chapter IV) baited with 250 gm of raw-fish as attractant (efficacy of this type of bait is described in Chapter II).

In all the experimental areas traps were operated from early morning after sunrise to sunset and traps were exposed to sunlight and air from all directions. Flies were collected and preserved at the end of each trapping period at each place.

(B) Composition of fly fauna in urban markets, Slaughter house and Garbage dump.

Composition of fly fauna of the main market places, slaughter house and the garbage dump of Jalpaiguri Town was studied with particular referenceto the following areas.

(a) Dinbazar - It is the oldest and the largest market (for vegetables, meat, fish and food grains) of Jalpaiguri Town, situated in its northern area, in the midst of thickly populated locality and on the bank of river Karolla. River Karolla is practically stagnant (with low velocity) and remains full of water hyacinth throughout the year. Sanitation and drainage system of this market is in a poor condition. Temporary garbage dumps are commonly observed at different corners of the market and there are open drains with stagnant water creating congenial condition for breeding of flies within or in the vicinity of the market.

Trap was placed in an open area adjacent to the vegetable and fish-stalls.

(b) Municipal market - It is a small market (for vegetables, meat, fish and food grains) in the western part of the town, about 1.5 km to the south-west of Dinbasar and situated within a well-populated residential area of Jalpaiguri Town. There are open drains but water does not stagnate. Temporary garbage dump (consisting of rotten fish and meat, fish entrails, excreta of animals, vegetable and rubbish from different shops) in an around the market constitute suitable breeding media for flies.

Trappings were made in an enclosure within the market area adjacent to fish and vegetable stalls.

(c) Slaughter house - It is a small tin-roofed hut about 1.5 km to the north-west of Dinbasar and 2.5 km to the north of Municipal market. This area of the town is sparsely populated and situated by the side of the road connecting Jalpaiguri and Siliguri. In this badly maintained hut a large number of sheep and goats are slaughtered regularly. Refuse of the slaughter house (viz., faecal matter, clotted blood, meat pieces etc.) are used as breeding media by flies.

Trap was placed inside the slaughter house.

(d) Municipal garbage dump - It is situated on the bank of river Karolla about 2.5 km to the north-west of Dinbasar and 3.5 km to the north of the Municipal market. The dump occupies and open field of 1.21 hectare of land and consists of refuse

from households, fruit industry, slaughter house and factories, as well as faecal matters, decomposed carcasbses etc.

Trap was placed at the fringe of the garbage dump.

Trappings were made twice during the months of May and September, with fish-baited traps, from early morning to sunset in all the experimental days.

(C) Altitudinal distribution.

For the purpose of this study roof of residential buildings of different heights (3.65 m, 7.01 m, 10.0 m, 13.10 m, 16.15 m and 19.20 m) and two microwave towers belonging to the Telecommunication Department (100 m high in both the cases) were selected. Simultaneous trappings were made on the ground level as well as at different heights of residential building on four occasions with cage traps each baited with 250 gm of rawfish in the months of May and September, 1978, when the annual activity of the flies was maximum in the area. Trappings were made at different heights of microwave tower in Jalpaiguri and Falakata.

Traps were placed at the trapping sites early in the morning and were released on the third day of each trapping period. Description of the trapping sites are given below:-

(a) In Jalpaiguri Town six residential houses of different heights (3.65 m, 7.01 m, 10.5 m, 13.10 m, 16.15 m and 19.20 m) were used as the trapping sites. These houses are

situated in the heart of the thickly populated area of the town and are more than 200 m apart from each other. In all these buildings traps were placed at the centre of the roof being fully exposed to sunlight and air from all sides.

(b) Two microwave towers were used for trappings - one is situated at the south-eastern fringe of Jalpaiguri Town, in front of a College and a Housing Estate. The other tower is at Joychandpur (near Falakata township), a small village about 79 km on the east of Jalpaiguri Town.

The surroundings of the microwave tower at Jalpaiguri is neat and clean and there is no open drain, stagnant water or garbage dump in the vicinity; but the tower at Joychandpur is surrounded by ponds, ditches, cattle-shed and scattered garbages. The traps were placed on the ground level as well as at six different levels of height (viz., 13 m, 23 m, 33 m, 40 m, 45 m and 50 m) of the tower. At different heights the fish-baited traps were fastened to the iron railings close to the ladder. Baits in all cases were placed inside a small box made of thin wire-mesh which was tied firmly to the legs of the trap as a precautionary measure against inquisitive birds. A circular tin plate (diameter 30.48 cm) was placed under each trap fastened to the tower providing a sustaining surface for the trap.

OBSERVATION

(A) Regional distribution of flies :

The results of trappings in different areas are summarised in Table No. 1. The main points of interest are as follows :

Urban areas

Alipurduar - Total number of flies trapped was 144 (of which 138 or 95.83% and 6 or 4.16% were females and males respectively) belonging to all the three families, five genera and eight species. Musca domestica was the most dominant species followed by Chrysomya megacephala, Parasarcophaga brevicornis, M. lucens, C. rufifacies, Hemipyrellia ligurriens, Lucilia cuprina and P. albiceps.

Dhubguri - Total number of flies trapped was 1090 (of which females and males were 1023 or 93.85% and 67 or 6.14% respectively) belonging to all the three families, four genera and eight species. Musca domestica was the most dominant species followed by Chrysomya megacephala, M. sorbens, M. pattoni, M. lucens, Lucilia cuprina, Parasarcophaga knabi and P. albiceps.

Falakata - Total number of flies trapped was 212 (of which 169 or 79.71% and 43 or 20.28% were females and males respectively) belonging to all the three families, four genera

and eight species. Musca domestica was the most dominant species followed by M. lucens, Chrysomya megacephala, M. sorbens, L. cuprina, Parasarcophaga knabi, P. albiceps and P. misera.

Jalpaiguri - Total number of flies trapped was 508 (of which females were 468 or 92.12% and males were 40 or 7.87% respectively) belonging to all the three families, seven genera and sixteen species. Chrysomya megacephala was the most dominant species followed by Musca sorbens, Parasarcophaga brevicornis, Hemipyrellia ligurriens, M. domestica, P. albiceps, M. lucens, P. knabi, C. rufifacies, H. pulchra, M. pattoni, Ophyra chalcogaster, Senior whitea krameri, Boettcherisca peregrina, P. ruficornis and P. misera.

Malbazar - Total number of flies trapped was 749 (consisting of 710 or 94.79% females and 39 or 5.20% males) belonging to all the three families, six genera and sixteen species. Musca domestica was the most dominant species followed by C. megacephala, M. lucens, M. sorbens, H. ligurriens, L. cuprina, H. pulchra, P. albiceps, P. knabi, P. orchidea, Chrysomya rufifacies, M. pattoni, M. crassirostris, M. ventrosa, Ophyra capensis and P. brevicornis.

Maynaguri - Total number of flies trapped was 1553 (consisting of 1458 or 93.88% females and 95 or 6.11% males) belonging to all the three families, four genera and eight species. Musca domestica was the most dominant species followed

by Chrysomya megacephala, M. sorbens, M. pattoni, M. lucens, M. crassirostris, Lucilia cuprina and P. albiceps.

Rural areas :

Bagrakote - Total number of flies trapped was 11 (of which 9 or 81.81% were females and 2 or 18.18% were males) belonging to two families (Muscidae and Sarcophagidae), two genera and four species. Musca domestica was the most dominant species followed by M. sorbens, M. crassirostris and Parasarcophaga ruficornis.

Bhelakoba - Total number of flies trapped was 1793 (of which 1634 or 91.13% were females and 159 or 8.86% were males) belonging to two families (Calliphoridae and Muscidae), four genera and nine species. Chrysomya megacephala was the most dominant species followed by Musca domestica, Lucilia cuprina, M. pattoni, Hemipyrellia ligurriens, H. pulchra, M. sorbens, C. rufifacies and M. lucens.

Berubari - Total number of flies trapped was 245 (of which females and males were 236 or 96.32% and 9 or 3.67% respectively) belonging to all the three families, four genera and seven species. Chrysomya megacephala was the most dominant species followed by Musca domestica, Lucilia cuprina, M. lucens, M. sorbens, Parasarcophaga knabi and P. brevicornis.

Birpara - Total number of flies trapped was 156 (of which females were 141 or 90.38% and males were 15 or 9.61%) belonging to three families, four genera and seven species. Musca domestica was the most dominant species followed by M. lucens, Chrysomya megacephala, M. pattoni, M. sorbens, Lucilia cuprina and Parasarcophaga misera.

Chalsa - Total number of flies trapped was 37 (of which females and males were 34 or 91.89% and 3 or 8.10% respectively) belonging to all the three families, four genera and seven species. Chrysomya megacephala was the most dominant species followed by Musca domestica, C. rufifacies, Hemipyrellia ligurriens, Parasarcophaga albiceps, M. sorbens and P. brevicornis.

Fatapukur - Total number of flies trapped was 23 (of which females were 21 or 91.30% and males were 2 or 8.69%) belonging to two families (Calliphoridae and Muscidae), three genera and five species. Musca domestica was the most dominant species followed by Chrysomya megacephala, Lucilia cuprina, M. lucens and M. pattoni.

Gairkata - Total number of flies trapped was 275 (of which females and males were 243 or 88.36% and 32 or 11.63% respectively) belonging to all the three families, four genera and seven species. Chrysomya megacephala was the most dominant species followed by Musca domestica, M. lucens, M. sorbens, Parasarcophaga albiceps, P. orchidea and Ophyra chalcogaster.

Hamilton ganj - Total number of flies caught was 50 (of which females were 47 or 94.0% and males were 3 or 6.0%) belonging to all the three families four genera and six species. Musca domestica was the most dominant species followed by Chrysomya megacephala, Lucilia cuprina, M. lucens, Parasarcophaga misera and M. pattoni.

Jalpesh - Total number of flies trapped was 150 (of which 134 or 89.33% were females and 16 or 10.66% were males) belonging to all the three families, seven genera and fourteen species. Chrysomya megacephala was the most dominant species followed by Musca lucens, M. domestica, C. rufifacies, Lucilia cuprina, Parasarcophaga brevicornis, Hemipyrellia ligurriens, L. sericata, M. ventrosa, Ophyra leucostoma, Parasarcophaga knabi, H. hempi, P. albiceps and M. pattoni.

Jaygaon - Total number of flies trapped was 111 (of which 96 or 86.48% and 15 or 13.51% were females and males respectively) belonging to all the three families, four genera and ten species. Musca domestica was the most dominant species followed by M. lucens, M. pattoni, Lucilia cuprina, M. sorbens, Parasarcophaga knabi, P. ruficornis, P. misera, P. orchidea and Chrysomya megacephala.

Kamakhyaguri - Total number of flies caught was 149 (of which females and males were 141 or 94.63% and 8 or 5.36% respectively) belonging to all the three families, four genera and ten species. The most dominant species was Musca domestica

followed by Chrysomya megacephala, Parasarcophaga misera, Musca sorbens, M. lucens, Hemipyrellia ligurriens, P. knabi, M. pattoni, M. crassirostris and P. brevicornis.

Kumargram - Total number of flies trapped was 55 (of which females and males were 53 or 96.36% and 2 or 3.63% respectively) belonging to all the three families, five genera and ten species. Chrysomya megacephala was the most dominant species followed by Musca domestica, Hemipyrellia ligurriens, M. sorbens, M. lucens, Parasarcophaga brevicornis, P. albiceps, Lucilia cuprina, M. pattoni and P. misera.

Madarihat - Total number of flies trapped was 309(of which females and males were 233 or 75.4% and 76 or 24.59% respectively) belonging to all the three families, three genera and eleven species. Chrysomya megacephala was the most dominant species followed by Musca domestica, Parasarcophaga knabi, M. sorbens, M. lucens, P. albiceps, P. orchidea, M. pattoni, M. crassirostris, P. ruficornis and P. misera.

Manikganj - Total number of flies trapped was 1176 (of which females were 1053 or 89.54% and males were 123 or 10.45%) belonging to x two families (Calliphoridae and Muscidae), three genera and six species. Musca domestica was the most dominant species followed by Chrysomya megacephala, M. pattoni, M. sorbens, Lucilia cuprina and M. lucens.

Mateli - Total number of flies caught was 185 (of which females and males were 135 or 72.97% and 50 or 27.02% respectively) belonging to all the three families, four genera and eleven species. Chrysomya megacephala was the most dominant species followed by Musca domestica, Lucilia sericata, M. lucens, Parasarcophaga knabi, P. misera, M. pattoni, M. crassirostris, P. brevicornis, P. ruficornis and P.albiceps.

Nagrakata - Total number of flies caught was 230 (of which females and males were 182 or 79.13% and 48 or 20.86% respectively) belonging to all the three families, six genera and eleven species. Chrysomya megacephala was the most dominant species followed by Musca domestica, Parasarcophaga knabi, Hemipyrellia ligurriens, Lucilia cuprina, Boettcherisca peregrina, M. sorbens, M. pattoni, P. brevicornis, P. ruficornis, and P. albiceps.

Odlabari - Total number of flies trapped was 43 (of which females were 38 or 88.37% and males were 5 or 11.62%) belonging to all the three families, five genera and ten species. Chrysomya megacephala was the most dominant species followed by Lucilia cuprina, Musca lucens, M. domestica, Hemipyrellia ligurriens, M. sorbens, M. pattoni, Parasarcophaga knabi, P. albiceps and P. orchidea.

Silbarihat - Total number of flies trapped was 152 (of which females and males were 119 or 90.15% and 13 or 9.84%

respectively) belonging to all the three families, four genera and seven species. Musca domestica was the most dominant species followed by Chrysomya megacephala, M. Lucens, C. rufifacies, M. pattoni, Iranihindia martellata and Parasarcophaga brevicornis.

Rural areas within the dense forest :

Jainti - Total number of flies caught was 164 (of which females were 160 or 97.56% and males were 4 or 2.43%) belonging to all the three families, four genera and twelve species. Chrysomya megacephala was the most dominant species followed by Musca domestica, C. rufifacies, Lucilia sericata, Lucilia papuensis, M. pattoni, Parasarcophaga knabi, P. misera, P. albiceps, M. lucens, P. brevicornis, and P. ruficornis.

Lankapara - Total number of flies caught was 140 (of which females were 120 or 85.71% and males were 20 or 14.28%) belonging to all the three families, five genera and eight species. Musca lucens was the most dominant species followed by M. domestica, M. sorbens, Chrysomya megacephala, Lucilia cuprina, P. misera, Iranihindia martellata and P. knabi. .

Lataguri - Total number of flies caught was 191 (of which females and Males were 153 or 80.10% and 38 or 19.89% respectively) belonging to all the three families, seven genera, and eleven species. Chrysomya megacephala was

the most dominant species followed by Musca domestica, M. sorbens, Paraseroophaga knabi, P. misera, P. orchidea, Lucilia papuensis, Iranihindia martellata, L. cuprina, P. brevicornis and Boettcherisca perigrina.

Uninhabited dense forest :

Khuttimari - Total number of flies caught was 34 (of which females were 19 or 55.88% and males were 15 or 44.11%) belonging to all the three families, five genera and eleven species. Chrysomya megacephala was the most dominant species followed by Paraseroophaga knabi, P. brevicornis, C. rufifacies, Lucilia papuensis, Musca sorbens, P. albiceps, Boettcherisca perigrina, M. lucens, P. orchidea and P. rufi-cornis.

Considering the results of trappings in all the above 28 localities as noted above, the consolidated result for the entire district is given as follows.

Total number of flies caught during the period of study of regional distribution of flies in Jalpaiguri District was 9918 (of which females were 90.44% and males were 9.55%) belonging to three families (viz. Calliphoridae, Muscidae and Sarcophagidae), ten genera and twenty-six species. Muscid flies (numbering 5933 or 59.82% of the total catch, consisted

of 90.57% females and 9.42% males) were most abundant followed by Calliphorid (numbering 3785 or 38.16% of the total catch, in which females and males were 91.17% and 8.82% respectively) and Sarcophagid (numbering 200 or 2.01% of the total catch, consisted of 72.50% and 27.50% females and males respectively) flies.

Muscid flies consisted of two genera and nine species of which Musca domestica, M. lucens and M. sorbens were the dominant species. Calliphorids were represented by three genera and seven species among which the dominant species were Chrysomya megacephala, Hemipyrellia ligurriens and C. rufifacies. Sarcophagids consisted of five genera and ten species. Parasarcophaga knabi, P. albiceps, P. misera and P. brevicornis were the dominant Sarcophagids of the area.

Chrysomya megacephala and Musca domestica were the most dominant flies of the district and were trapped from all the localities excepting Nagrakot where no C. megacephala was trapped and Khuttimari where M. domestica was absent.

Males and females of all the species were trapped in the district except Musca crassirostris, Musca ventrosa, Ophyra chalcogaster, O. leucostoma, O. capensis, Lucilia papuensis and Iranihindia martellata were represented by females and Harpagophalla kempi and Seniorwhitea krameri were represented by males only.

(B) Composition of fly fauna in urban markets, Slaughter house and Garbage dump.

In total 2149 flies (of which females were 83.99% and males were 16.0%) were trapped during the study of fly composition at four different areas (Dinbasar, Municipal market, Slaughter house and Garbage dump) of Jalpaiguri Town, belonging to three families (Calliphoridae, Muscidae and Sarcophagidae), nine genera and twenty-two species. Calliphorid flies numbering 1484 or 69.05% of the total catch (where females were 85.84% and males were 14.15%) were most abundant in the catch, followed by Muscids numbering 623 or 28.99% of the total catch (of which females and males were 81.86% and 18.13% respectively) and Sarcophagids numbering 42 or 1.95% of the total catch (of which females were 50.0% and males were 50.0%).

Calliphorids consisted of three genera and five species among which Chrysomya megacephala was dominant, followed by Hemipyrellia ligurriens. Muscids were represented by four genera and ten species, among which the dominant species was Musca domestica, followed by M. sorbens and M. lucens. Sarcophagid flies were represented by two genera and seven species, among which Parasarcophaga albiceps was dominant.

Only the females were collected in case of H. pulchra, Lucilia cuprina, M. crassirostris, M. ventrosa, M. fasciata, Synthesomyia nudisetta, Ophyra chalcogaster, Stomoxis calcitrans

and Parasarcophaga brevicornis and only the males were collected in case of Parasarcophaga knabi, P. ruficornis, Pierretia calicifera and Seniorwhitea krameri. Both the males and females were collected in case of all other species.

The results obtained in different trapping areas of the town were as follows (See Table No. 2).

Dinbasar - Total number of flies trapped were 1106 or 51.46% of the total catch (in which 82.64% and 17.35% were females and males respectively) and consisted of five genera and twelve species. Chrysomya megacephala was the most dominant species followed by Musca domestica, M. sorbens, Hemipyrellia ligurriens, Parasarcophaga albiceps, M. lucens, C. rufifacies, M. pattoni, H. pulchra, Ophyra chalcogaster, P. brevicornis and P. misera.

Municipal market - Total number of flies trapped were 617 or 28.71% of the total catch (where females and males were 88.33% and 11.66% respectively) and consisted of five genera and thirteen species. Chrysomya megacephala was the most dominant species followed by Musca domestica, M. sorbens, M. fasciata, M. lucens, Hemipyrellia ligurriens, M. crassirostris, M. pattoni, M. ventrosa, C. rufifacies, Synthesomyia nudiseta, Parasarcophaga albiceps and P. misera.

Slaughter house - Total number of flies trapped were 67 or 3.11% of the total catch (in which females were 77.61%

and males were 22.38%) and consisted of three genera and six species. Musca domestica was the most dominant species followed by M. sorbens, Lucilia cuprina, M. lucens, Parasarcophaga knabi and P. ruficornis.

Garbage dump - Total number of flies trapped were 359 or 16.7% of the total catch (in which females were 81.89% and males were 18.10%) and consisted of seven genera and fifteen species. Musca lucens was the most dominant species followed by M. sorbens, Chrysomya megacephala, Hemipyrellia ligurriens, H. pulchra, M. domestica, M. crassirostris, C. rufifacies, Ophyra chalcogaster, Stomoxis calcitrans, Parasarcophaga misera, P. knabi, P. albiceps, Musca fasciata and Seniorwhitea krameri.

(C) Altitudinal distribution :

Total number of flies trapped during the experiment was 5355 (of which females were 4764 or 88.96% and males were 591 or 11.03%) belonging to three families (Calliphoridae, Muscidae and Sarcophagidae), eleven genera and twenty four species. Muscid flies numbering 2916 or 54.45% of the total catch (of which females and males were 2577 or 80.37% and 339 or 11.62% respectively) were most abundant in the catch, followed by Calliphorid flies numbering 2219 or 41.43% of the total catch (of which females were 2033 or 91.61% and males

were 186 or 8.38%) and Sarcophagid flies numbering 220 or 4.10% of the total catch (of which females and males were 154 or 70.0%, and 66 or 30.0% respectively).

Collection at roof top of different residential buildings (see Table 3)

Total number of flies trapped was 4150 or 77.49% of the total catch (of which females and males were 3770 or 90.84% and 380 or 9.15% respectively), consisting of three families, eleven genera and twenty-four species. Muscid flies dominanted the catch followed by Calliphorid and Sarcophagid flies. Musca domestica (50.65%) was the dominant species followed by Chrysomya megacephala, M. sorbens, M. lucens, C. rufifacies, Paresarcophaga misera, M. pattoni, P. brevicornis etc.

Collection at different heights of microwave tower (see Table-4a, b)

(A) Microwave tower (Jalpaiguri) - Total number of flies trapped was 806 or 15.05% of the total catch (of which females were 700 or 86.84% and males were 106 or 13.15%), belonging to three families, five genera and fourteen species. Calliphorid flies were abundant in the catch followed by Muscid and Sarcophagid flies. Chrysomya megacephala (82.87%) was the most dominant species followed by Musca sorbens, M. domestica, Paresarcophaga brevicornis etc.

(B) Microwave tower (Falakata) - Total number of flies trapped was 399 or 7.45% of the total catch (of which females were 294 or 73.68% and males were 105 or 26.31%) belonging to three families, four genera and seven species. Muscid flies were dominant in the catch followed by Calliphorid and Sarcophagid flies. Musca domestica (71.67%) was the most dominant species followed by Chrysomya megacephala, M. lucens, M. sorbens etc.

Calliphorid flies were trapped upto 16.15 m and 23 m heights in roof top and microwave tower respectively and consisted of three genera and six species of which Chrysomya megacephala was the dominant fly followed by C. rufifacies. Muscid flies were trapped from 43 m height in Falakata tower while Muscid flies were absent in the catches of Jalpaiguri tower. But the catches from the roof-top of residential buildings in Jalpaiguri Town showed that Muscid flies occurred upto a height of 19.20 m. Muscids were represented by three genera and seven species of which the dominant species was Musca domestica followed by M. sorbens and M. lucens. Sarcophagid flies were trapped from 50 m height and consisted of five genera and eleven species of which the dominant species was Parasarcophaga misera followed by P. brevicornis and P. ruficornis. No flies were trapped above 50 m height.

Only females were collected in case of Lucilia sericata, Ophyra chalcogaster, O. leucostoma, Iranihindia martellata, Seniorwhitea krameri and Parasarcophaga orchidea and only males were collected in case of Harpagophallakempi and P. hirtipes. Both the males and females were collected in case of all other species.

DISCUSSION

(A) Regional distribution of flies :-

Studies on the distribution of flies revealed that Calliphorid, Muscid and Sarcophagid flies were more or less uniformly distributed in both urban, rural and forest areas of the District. In all the places, Chrysomya megacephala and Musca domestica dominated the catch, except in Khuttimari forest area where Musca domestica was totally absent. The absence of this species in the dense forest area may be attributed to their highly synanthropic nature (Roy and Dasgupta, 1980). The synanthropic nature of this fly is further shown by the fact that they were trapped in greater numbers in areas with comparatively higher human population.

No clear-cut distinction could be made between urban and rural species of the area. C. megacephala, M. domestica, C. rufifacies, Lucilia cuprina, M. sorbens, M. lucens, Parasarcophaga knabi, P. brevicornis, P. albiceps and P. misera are very widely distributed species in urban as well as in rural areas of the district. However the pre-dominant species of the urban areas are C. megacephala, H.ligurrins Hemipyrellia pulchra, L.cuprina, M. domestica, M. sorbens, M. pattoni, Ophyra chalcogaster, P. knabi, P. brevicornis, P. misera and P. albiceps, while C. rufifacies, Lucilia sericata, M. orassirostris, M. ventrosa, Ophyra leucostoma, P. ruficornis, Iranihindia

martellata etc are pre-dominant species in the rural areas. Lucilia sericata, Musca lucens, Parasarcophaga orchidea and Boettcherisca peregrina were trapped in open fields as well as in the forest areas of the District. Lucilia papuensis occoured only in the dense forest in the northern part of the district indicating its wild and asynanthropic nature.

Calliphorids and Musoids, except Musca lucens, were very well-distributed in the western part of the District while Sarcophagids were abundantly found in the eastern part. Chrysomya megacephala, Hemipyrellia ligurriens, Lucilia cuprina, Musca domestica, M. sorbens and M. pattoni are well-distributed species on the western part of the District whereas Parasarcophaga knabi, P. misera, P. brevicornis, Iranihindia martellata and Musca lucens were abundantly distributed species in the eastern part. Some species of Sarcophagids viz., P. ruficornis, P. orchidea and P. albiceps were dominant in the north-eastern part of the District. Abundandance of different species also xxx varied within the District from place to place. Abundance of H. ligurriens, M. lucens, P. ruficornis and P. albiceps increased in the north and decreased in the south, but abundance of L. cuprina, M. pattoni, M. domestica and P. brevicornis increased in the south and decreased in the north. P. knabi and P. orchidea were dominant species in the north-eastern parts of the

District. Abundance of Chrysomya megacephala seemed to be correlated to the density of human population.

Lucilia sericata, L. ampullacea, L. papuensis, Calliphora pattoni, Ophyra leucostoma and Musca fasciata were trapped in the present study area for the first time.

It was worthwhile to compare here the fly fauna of Jalpaiguri Town with that of Siliguri and Calcutta in the light of data furnished by Roy and Dasgupta (1975) for Siliguri and by Das (1980) for Calcutta. Four species of Calliphorids and eight species of Sarcophagids were common in all the areas. Siliguri and Calcutta showed in common four species of Calliphorids and nine species of Sarcophagids, but Siliguri and Jalpaiguri showed five common species of Calliphorids, thirteen species of Muscids and nine species of Sarcophagids. Chrysomya albiceps, C. nigripes, Miltogoninae sp. and Pandelleisca bainbriggei were trapped from Calcutta only but not from Jalpaiguri and Siliguri areas. Similarly, H. pulchra and Pierretia calcifera were available in Siliguri and Jalpaiguri but not in Calcutta. L. ampullacea, L. papuensis, Calliphora pattoni, M. fasciata, O. leucostoma, Harpagophalla kempi and Sarcosolomonia orinita were trapped only from Jalpaiguri District while L. illustris, Ophyra obscurifrons and Seniorwhitea orientaloides were caught only from Siliguri. S.krameri and L. sericata were trapped from

Calcutta and Jalpaiguri but not from Siliguri. Comparative study of fly fauna of the above three places also revealed that the abundance of Chrysomya xx rufifacies decreased in the northern latitudes of the State while Parasarcophaga knabi, P. brevicornis, P. albiceps, P. orchidea, P. hirtipes and Boettcherisca peregrina were more abundant in the north and their numbers decreased in the southern latitudes. Lucilia cuprina, P. ruficornis and P. misera were available equally in southern and northern latitudes but the numbers of Ophyra capensis, Synthesomya nudiseta and Dichaetomya sp. which were found in Siliguri-Jalpaiguri areas, seemed to increase eastward.

(B) Composition of fly fauna in urban markets, slaughter house and garbage dump.

Comparative study of fly composition in two urban markets, slaughter house and garbage dump of Jalpaiguri revealed that Calliphorid, Muscid and Sarcophagid flies were available in all the places but the composition and abundance of different species varied from place to place. Dominant flies of market were C. megacephala, C. rufifacies, Musca domestica, M. pattoni, M. fercinta, P. brevicornis and P. albiceps, while that of garbage dumps were H. ligurriens, M. lucens, O. chalcogaster, P. knabi and P. misera. M. sorbens were trapped more or less in equal numbers in all the localities. In Finland (Nuorteva,

1964) adults of blowflies were abundant in an area where suitable breeding materials were available. The highest catches of Chrysomya megacephala and C. rufifacies in markets of Jalpaiguri Town was attributable to the available fish and fish-entrails in markets which were their most favoured breeding media. Similarly the greater number of Hemipyrellia ligurriens in the garbage dumps could be attributed to their habit of breeding in garbage rich in decaying animal matters (Senior White et al., 1940). Greater abundance of Musca domestica, M. pattoni, P. bravicornis, P. albiceps in fish and vegetable markets and M. lucens, Ophyra chalcogaster, P. knabi and P. misera in garbage dumps might possibly be due to the availability of preferred breeding material (Fukuda, 1960b; Suenaga et al., 1964 and Shinonaga, 1965) in garbage dump.

Another pattern which emerged out of this study was the occurrence of comparatively greater number of males in the fish-baited trap of market places and garbage dump than in the fish-baited traps operated in fields (see Table No. 5). Norris (1959) observed in Australia that males leave favourable habitat less often than females. Since the traps were operated well inside the market places and garbage dumps which possibly were the favoured breeding grounds of flies in study area, the number of males were relatively greater in these traps.

whereas the traps in the field though baited with fish were at a much greater distance from the breeding grounds.

Table No. 5

Comparative percentages of male and female flies in fields, markets, slaughter house and garbage dump.

Sl. No.	Name of the trapping sites.	Total number of flies trapped.	% of female flies trapped.	% of male flies trapped.
1.	Jalpaiguri Fire Brigade	508	92.12%	7.87%
2.	Alipurduar	144	95.83%	4.16%
3.	Dinbazar	1106	82.64%	17.35%
4.	Municipal Market	617	88.33%	11.66%
5.	Slaughter House	67	77.61%	22.38%
6.	Garbage Dump	359	81.89%	18.10%

Aradi and Mihalyi (1971) during their investigations on flies visiting food market in Budapest, found that the composition of flies in four different markets were similar and the numerical proportion of several species varied in different markets which he assumed was due to their breeding habit on or in the vicinity of the market. A similar result has been obtained in the present study also.

(C) Altitudinal distribution:

Altitudinal distribution of flies at different levels of the Microwave tower and on the roof-tops of buildings of different heights revealed that maximum number of flies were trapped between 23 m to 33 m beyond which a sharp decrease in their numbers occurred.

Calliphorid flies were abundant at lower level (ground level to 7.01 m) than in higher levels (10.05 m to 19.20 m) where Muscid and Sarcophagid flies dominated the catch. Sarcophagids on the other hand were trapped at the highest zone (50 m) where Muscids could not reach.

Findings of Nuorteva (1964b) in Ailigas hill, Finland, that the number of Calliphorids in general decreased with increased elevations seemed to be true in the present study also. The percentage of Calliphorids gradually decreased with increased elevations and the flies were completely absent beyond 23 m from ground level (which at the place of collection was 90 m and 64 m respectively from mean sea level).

The present study reveals that the percentage of males in Musca domestica and M. sorbens increased at the higher altitudes while that of males of Callipherids and Sarcophagids in general decreased. There was however a great disparity in the number of flies trapped on Microwave Towers

and on roof-tops of different residential buildings (see Table No. 3 & 4). This was possibly because of the location of residential buildings in congested part of the town, and the location of the tower in a non-congested area. The existence of dissimilar sustaining surfaces in the two places was also a contributory factor.

SUMMARY

1. With regard to distribution of flies in Jalpaiguri District the following conclusions are drawn :-

(a) Calliphorid, Muscid and Sarcophagid flies are more or less uniformly distributed in different urban, rural and forest areas of Jalpaiguri District.

(b) The following species are found predominant in urban areas :

Chrysomya megacephala, *Hemipyrellia ligurriens*, *H. pulchra*, *Lucilia cuprina*, *Musca domestica*, *M. sorbens*, *M. pattoni*, *Ophyra chalcogaster*, *Parasarcophaga knabi*, *P. brevicornis*, *P. misera* and *P. albiceps*;

and

the following species are found predominant in rural areas :

C. rufifacies, *L. sericata*, *M. crassirostris*, *M. ventrosa*, *O.leucostoma*, *P. ruficornis* and *Iranihindia martellata*.

(c) *Lucilia papuensis* is a wild and asynanthropic species found in the north-eastern part of Jalpaiguri District.

(d) *C. megacephala*, *H. ligurriens*, *L. cuprina*, *Musca domestica*, *M. sorbens* and *M. pattoni* are found in abundance in the western part of the District, whereas *P. knabi*, *P. misera*,

Paraseroophaga brevicornis, Iranihindia martellata and Musca lucens are abundant in the eastern part. The abundance of Hemipyrellia ligurriens, M. lucens, P. ruficornis and P. albiceps increases in the north and decreases in the south, while the abundance of Lucilia cuprina, M. pattoni, M. domestica and P.brevicornis increases in the south and decreases in the north.

2. With regard to the known data regarding distribution of flies in the State of West Bengal the following conclusion is drawn :-

Chrysomya megacephala, H. ligurriens, P. knabi, P. brevicornis, P. albiceps, P. orchidea, P. hirtipes and Boettcherisca peregrina are more abundant in the northern parts of the State while their numbers progressively decrease in southern latitudes. Conversely, the abundance of C.rufifacies decreases northwards.

3. With regard to data on the distribution of flies in garbage dump and the market places in Jalpaiguri Town the following conclusions are drawn :-

(a) Chrysomya megacephala and C.rufifacies are the dominant flies in the markets, while H. ligurriens dominates the catch in garbage dumps of Jalpaiguri Town.

(b) Relatively greater percentage of males were trapped using fish-bait in market places and garbage dump, than

in the open fields.

4. With regards to data on altitudinal distribution of flies the following conclusions are drawn :-

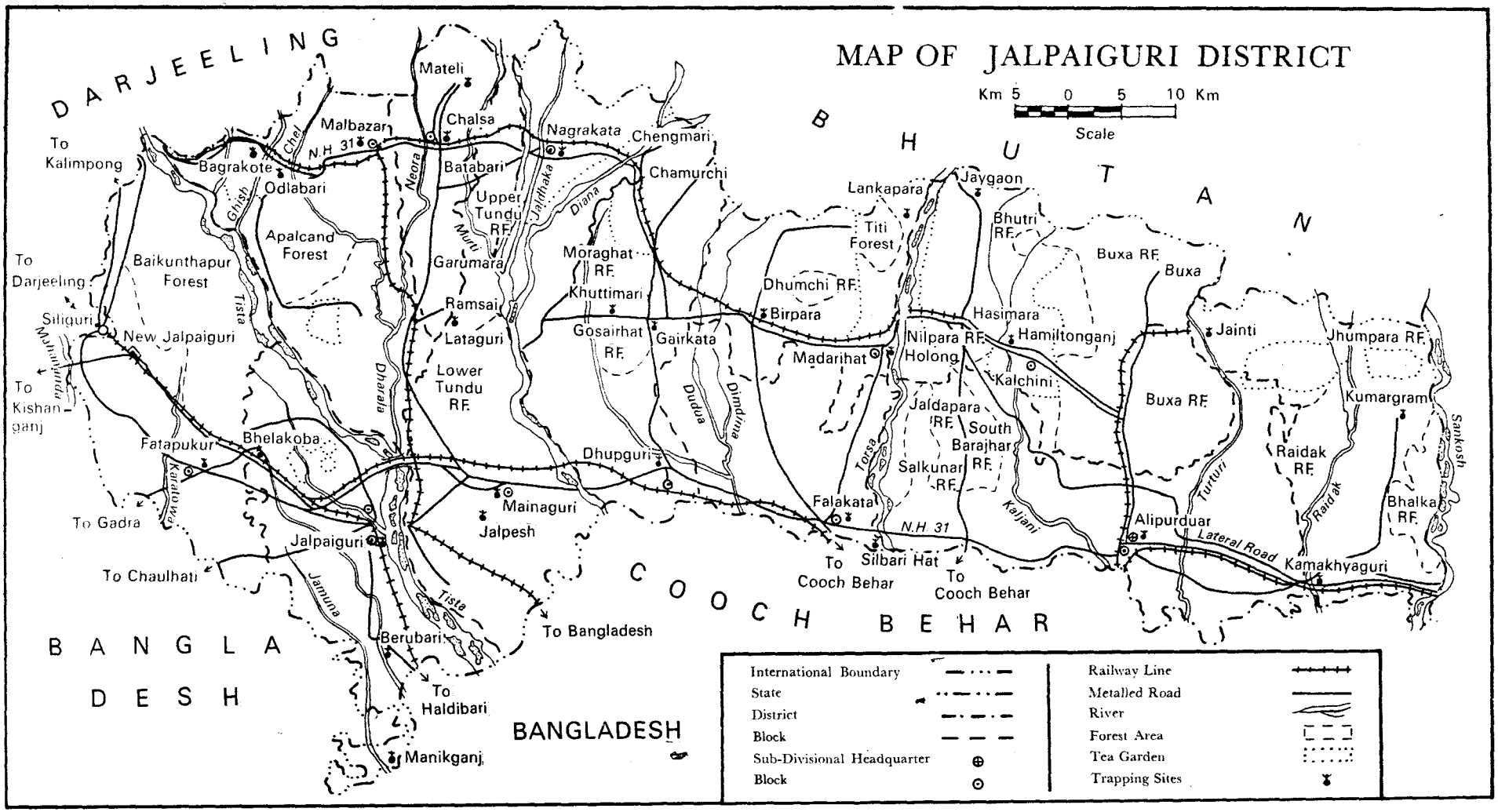
(a) Flies are trapped in larger numbers between 23 m to 33 m, even more than at the ground level of Jalpaiguri Town (90 m, mean sea level).

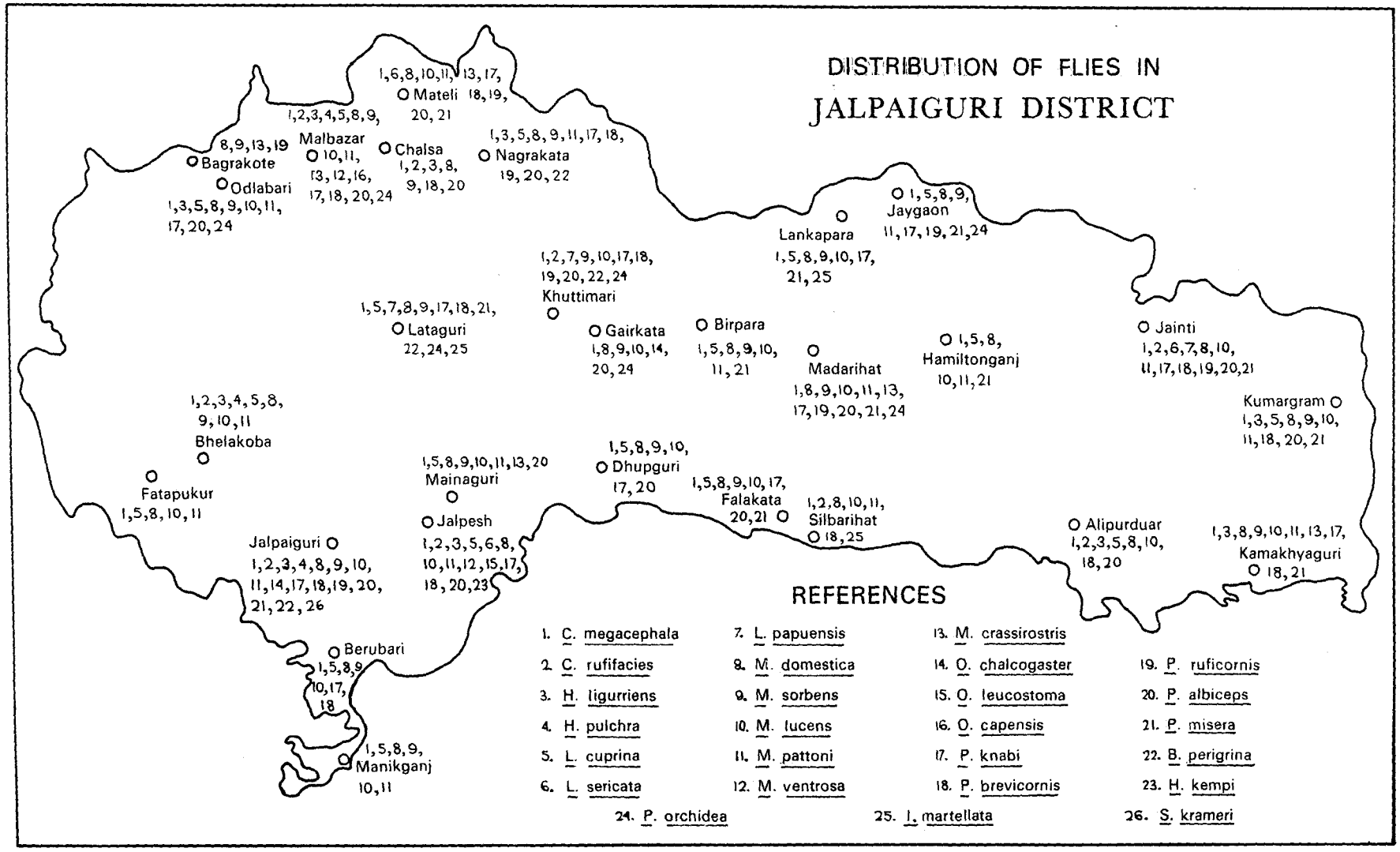
(b) Sarcophagids are trapped at the 50 m level while Calliphorids and Muscids are absent at that level. Beyond 50 m level all the flies are absent. Calliphorids ascended the height of 13 m and 23 m level in rural (Falakata, 64 m mean sea level) and urban areas (Jalpaiguri) respectively while Muscids occurred upto 43 m in rural (Falakata) area and 19.20 m from ground level in Jalpaiguri Town.

(c) Percentage of males in Musca domestica and M. sorbens increased at the higher level while that of the males of Calliphorids and Sarcophagids decreased with elevation.

FIGURES AND TABLES

AREA UNDER STUDY
INDIA
Jalpaiguri
West Bengal


MAP OF JALPAIGURI DISTRICT
Km 5 0 5 10 Km
Scale
DARJEELING
BHUTAN
COOCH BEHAR
BANGLA DESH
BANGLADESH
To Kalimpong
To Darjeeling
To Kishanganj
To Gadra
To Chaulhati
To Bangladesh
To Haldibari
Siliguri
New Jalpaiguri
Fatapukur
Bhelakoba
Jalpaiguri
Berubari
Manikganj
Bagrakote
Odlabari
Malbazar
Mateli
Chalsa
Batabari
Nagrakata
Chengmari
Chamurchi
Upper Tundu RF.
Garumara
Ramsai
Lataguri
Lower Tundu RF.
Moraghat RF.
Khuttimari
Gosairhat RF.
Gairkata
Dhupguri
Mainaguri
Jalpesh
Apalcand Forest
Baikunthapur Forest
Lankapara
Titi Forest
Jaygaon
Bhutri RF.
Buxa RF.
Buxa
Dhumchi RF.
Birpara
Madarihat
Nilpara RF.
Holong
Hasimara
Hamiltonganj
Kalchini
Jaldapara RF.
South Barajhar RF.
Salkunar RF.
Falakata
Silbari Hat
To Cooch Behar
To Cooch Behar
Alipurduar
Jainti
Jhumpara RF.
Kumargram
Raidak RF.
Bhalka RF.
Kamakhyaguri
Lateral Road
N.H. 31
Ghish
Chel
Neora
Murti
Jaldhaka
Diana
Tista
Dharala
Karatowa
Jamuna
Dudua
Dimdima
Torsa
Kaljani
Turturi
Raidak
Sankosh
International Boundary
State
District
Block
Sub-Divisional Headquarter
Block
Railway Line
Metalled Road
River
Forest Area
Tea Garden
Trapping Sites


DISTRIBUTION OF FLIES IN
JALPAIGURI DISTRICT
1,6,8,10,11,13,17,
18,19,
Mateli
20,21
1,2,3,4,5,8,9,
8,9,13,19
Bagrakote
Odlabari
1,3,5,8,9,10,11,
17,20,24
Malbazar
10,11,
13,12,16,
17,18,20,24
Chalsa
1,2,3,8,
9,18,20
1,3,5,8,9,11,17,18,
Nagrakata
19,20,22
1,5,8,9,
Jaygaon
11,17,19,21,24
Lankapara
1,5,8,9,10,17,
21,25
1,2,7,9,10,17,18,
19,20,22,24
Khuttimari
1,5,7,8,9,17,18,21,
Lataguri
22,24,25
Gairkata
1,8,9,10,14,
20,24
Birpara
1,5,8,9,10,
11,21
Madarihat
1,8,9,10,11,13,
17,19,20,21,24
1,5,8,
Hamiltonganj
10,11,21
Jainti
1,2,6,7,8,10,
11,17,18,19,20,21
Kumargram
1,3,5,8,9,10,
11,18,20,21
1,2,3,4,5,8,
9,10,11
Bhelakoba
Fatapukur
1,5,8,10,11
1,5,8,9,10,11,13,20
Mainaguri
1,5,8,9,10,
Dhupguri
17,20
1,5,8,9,10,17,
Falakata
20,21
1,2,8,10,11,
Silbarihat
18,25
Jalpesh
1,2,3,5,6,8,
10,11,12,15,17,
18,20,23
Jalpaiguri
1,2,3,4,8,9,10,
11,14,17,18,19,20,
21,22,26
Alipurduar
1,2,3,5,8,10,
18,20
1,3,8,9,10,11,13,17,
Kamakhyaguri
18,21
Berubari
1,5,8,9,
10,17,
18
1,5,8,9,
Manikganj
10,11
REFERENCES
1. C. megacephala
2. C. rufifacies
3. H. ligurriens
4. H. pulchra
5. L. cuprina
6. L. sericata
7. L. papuensis
8. M. domestica
9. M. sorbens
10. M. lucens
11. M. pattoni
12. M. ventrosa
13. M. crassirostris
14. O. chalcogaster
15. O. leucostoma
16. O. capensis
17. P. knabi
18. P. brevicornis
19. P. ruficornis
20. P. albiceps
21. P. misera
22. B. perigrina
23. H. kempi
24. P. orchidea
25. I. martellata
26. S. krameri

MICRO WAVE TOWER AT JALPAIGURI

MICRO WAVE TOWER AT FALAKATA

Table No. 1. Number of Calliphorid flies trapped in different localities of Jalpaiguri District.

Locality Nos-		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Name of the place :- / Species.		Alipurduar	Dhubguri	Falakata	Jalpaiguri Town	Malbazar	Mayaguri	Nagrakote	Bhelakoba	Berubari	Birpara	Chalsa	Patkapkur	Gairkata	Hamiltongunj	Jalpesh	Jaygaon	Kamakhyaguri	Kumargram	Madaribat	Mankganj	Matelli	Nagrakata	Odlabari	Silbaribat	Jainti	Lankapara	Lataguri	Khuttimari
1. Chrysomya megacephala	♀	6	217	16	397	166	253		1026	163	8	18	5	169	7	79	1	32	37	150	105	106	93	16	22	90	6	88	9
	♂		8		25	5	6		103	2		3	1	15		7		1		42	5	42	21		1			19	6
2. Chrysomya rufifacies	♀				1	2			1			3				6									2	8			
	♂	1			1											4										1		2	
3. Hemipyrellia ligurriens	♀	1			6	9			4			2				3		1	2				6	3					
	♂				2	3																							
4. Hemipyrellia pulchra	♀				1	4			5																				
	♂																												
5. Lucilia cuprina	♀	1	2	1		8	1		18	20	1		5		1	5	6				4		5	5			4	1	
	♂								1				1			1			1					2			1		
6. Lucilia sericata	♀															1						2			1				
	♂																					1							
7. Lucilia papuensis	♀																									2		1	1
TOTAL CALLIPHORID FLY:	♀	8	219	17	405	189	254		1054	183	9	23	10	169	8	94	7	33	39	150	109	108	104	24	24	101	10	90	10
	♂	1	8		28	8	6		104	2		3	2	15		12		1	1	42	5	43	21	2	1	1	1	19	8

Table No. 1. Number of Muscid flies trapped in different localities of Jalpaiguri District.

Locality No:-		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Name of the place :- / Species.		Alipurduar	Dhubguri	Falakata	Jalpaiguri Town	Malbazar	Maynaguri	Nagrakote	Phelakoba	Berubari	Birpara	Chalsa	Patapukur	Gairkata	Hamiltonganj	Jalpesh	Jayanon	Kamakhyaguri	Kumargram	Madarihat	Manikganj	Matelli	Nagrakata	Odlabari	Silbarihat	Jalpti	Lankapara	Lataguri	
1. Musca domestica	♀	125	769	126	7	464	1133	6	565	44	117	7	9	58	36	11	66	95	5	60	931	18	63	5	76	42	35	43	
	♂	5	47	31		29	79		48	4	8			10	3		7	6		13	114	4	18		8	1	3	15	
2. Musca sorbens	♀		21	6	22	13	43	2	4	1		1		1			3	2	2	6	4		2				8	
	♂		8	10	6		8	1		1	4			4			1			8	1			1			12	1	1
3. Musca lucens	♀	3	6	18	4	25	7		1	7	10		1	14	1	13	12	2	2	5		3		7	15	1	72		1
	♂		1	1		1				1	1					3	1			2	1				4		3		
4. Musca pattoni	♀		7		1	4	13		10		4		1		1	2	6		1	1	9		2	1	2	2			
	♂																												
5. Ophyra chalcogaster	♀				1									1															
	♂																												
6. Ophyra leucostoma	♀															2													
	♂																												
7. Musca crassirostris	♀					1	7	1										1		1		1							
	♂																												
8. Musca ventrosa	♀					1										2													
	♂																												
9. Ophyra capensis	♀					1																							
	♂																												
TOTAL MUSCIDS FLIES:	♀	128	803	150	35	509	1203	9	580	52	131	8	11	74	38	30	87	100	10	73	944	22	67	13	93	45	107	51	1
	♂	5	58	42	6	30	89	1	55	6	15			14	3	3	12	7		23	118	5	18	1	12	1	18	16	1

Table No. 1. Number of Sarcophagid flies trapped in different localities of Jalpaiguri District.

Locality No:-		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Name of the place :- / Species:		Alipurduar	Dhubguri	Falakata	Jalpaiguri Town	Malbazar	Maynaguri	Bagrakote	Bhelakoba	Berubari	Birpara	Chalsa	Fatapukur	Gairkata	Hamiltonganj	Jalpesh	Jaygaon	Kamakhyaguri	Kumargram	Madarihat	Manikganj	Matelli	Nagrakata	Odlabari	Silbarihat	Jainti	Lankapara
1. Parasarcophaga knabi	♀			1		4										3	1	1		7		2	6			4	
	♂		1		3	1				1							1			8			4				1
2. Parasarcophaga brevicornis	♀	4			20	1				1		1				6		1	2			1	2		1	1	
	♂				1																						
3. Parasarcophaga ruficornis	♀				1															1			2			1	
	♂							1									1					1				1	
4. Parasarcophaga albiceps	♀	1	1		6	5	1					2				1			2	1				1		4	
	♂			1										2						1		1	1				
5. Parasarcophaga misera	♀			1	1						1				1			6				2				4	2
	♂																1		1	1						1	
6. Boettcherisca perigrina	♀																						1				
	♂				1																		4				
7. Harpagophalla kempi	♀																										
	♂															1											
8. Parasarcophaga orchidea	♀					2											1			1							
	♂													1						1				1			
9. Iranihindia martellata	♀																								1		1
	♂																										
10. Seniorwhitea krameri	♀																										
	♂				1																						
TOTAL SARCOPHAGIDS :	♀	5	1	2	28	12	1			1	1	3			1	10	2	8	4	10		5	11	1	2	14	3
	♂		1	1	6	1		1		1				3		1	3		1	11		2	9	2		2	1

Table No. 2. Number of flies trapped in simultaneous trapping in two markets, slaughter house and garbage dump of Jalpaiguri Town.

SPECIES.	Municipal Market				Dinbasar Market				Slaughter House				Garbage Dump				TOTAL		GRAND TOTAL
	30.7.75		16.10.75		30.7.75		16.10.75		30.7.75		16.10.75		30.7.75		16.10.75				
	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	
Chrysomya megacephala	166	2	224	40	326	75	405	60					10	3	55	8			1550
Chrysomya rufifacies			2		4	1	10						4		7				28
Hemipyrellia ligurriens	2		3	1	11	3	9	3					15	4	23	9			85
Hemipyrellia pulchra					2								5		9	1			17
Lucilia cuprina									4										4
Total Calliphorid Sex:	168	2	229	41	343	77	422	65	4				34	7	74	18	1274	210	1484
Musca domestica	41	8	42	3	33	18	19	8	10	3	12	5	3		8	2			217
Musca sorbens	8		28	17	16	9	39		8		18	4	20		41	5			213
Musca lucens	6					2	18	7			1		30	9	43	11			127
Musca crassirostris	4												8		7				19
Musca pattoni			4		4	1	5												14
Musca ventrosa			3																3
Musca fasciata			10												1				11
Synthesomyia nudiseta			1																1
Ophyra chalcogaster							2						5		3				10
Stomoxis calcitrans													3		5				8
Total Muscid Sex:	59	8	88	20	53	30	85	15	18	4	30	9	71	9	108	18	510	113	623
Paraesarcophaga knabi												1		5	5	2			9
Paraesarcophaga brevicornis					4		3												7
Paraesarcophaga ruficornis												1							1
Paraesarcophaga albiceps				1	3	3	3						1	1		1			13
Paraesarcophaga misera			1					2					1	2	2	3			11
Total Sarcophagid Sex:			1	1	7	3	6	2				2	2	7	5	6	21	21	42
GRAND TOTAL:-	345	72 (617)			914	192 (1106)			52	15 (67)			294	65 (359)					2149

Table No. 3. Number of flies trapped on the roof tops of buildings of different heights of Jalpaiguri Town.

Species.		Ground level.	Heights of different roof tops.						TOTAL
			3.65m	7.01m	10.0m	13.10m	16.15m	19.20m	
Chrysomya megacephala	♀	16	122	782	252	133	2		1307
	♂	1	5	57	13	2	1		79
Chrysomya ruffifacies	♀		5	26	11	2			44
	♂		2	12	4	1			19
Hemipyrellia liguriens	♀	2	1	4	1				8
	♂			3					3
Hemipyrellia pulchra	♀	1		1	1				3
	♂								
Lucilia cuprina	♀	1	2	1	1				5
	♂	1							1
Lucilia sericata	♀	1							1
TOTAL CALLIPHORID:		23	137	886	283	138	3		1470
Musca domestica	♀	36	209	526	795	400	15	2	1983
	♂	4	8	27	54	21	5		119
Musca sorbens	♀	4	6	6	88	4			108
	♂	2	10	7	16	26	10	1	72
Musca lucens	♀	3	32	41	24	56	5	2	163

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Continuation sheet of Table No. 3.

Species.		Ground level.	Heights of different roof tops.						TOTAL
			3.65m	7.01m	10.0m	13.10m	16.15m	19.20m	
Musca lucens	♂			8	8	4			20
Musca pattoni	♀		4	8	6		2	2	22
	♂			2	10				12
Ophyra chalcogaster	♀			2	1				3
	♂								
Ophyra leucostoma	♀				2				2
Synthesomyia nudiseta	♀	2	1	4	1				8
	♂		1						1
TOTAL MUSCID:		51	271	631	1005	511	37	7	2513
Parasarcophaga knabi	♀			1	3	2	1		7
	♂		1	4	3	3			11
Parasarcophaga brevicornis	♀	2	3	11	5		3	2	26
Parasarcophaga ruficornis	♀		3	5		4	3	1	16
	♂					2	1		3
Parasarcophaga misera	♀		1	7	13	15	6	3	45
	♂		5	6	16	6	1	1	35
Parasarcophaga albiceps	♀	1	1	1			1		4
Iranihindia martellata	♀	1	1	1	1	1			5

/Contd...

Continuation sheet of Table No. 3.

Species.		Ground level.	Heights of different roof tops.						TOTAL
			3.65m	7.01m	10.0m	13.10m	16.15m	19.20m	
Boettcherisca peregrina	♀							1	1
	♂			2	1				3
Harpagophalla kempi	♀								
	♂			1					1
Seniorwhites kraemeri	♀			1	2	3		1	7
Paraesarcophaga hirtipes	♂					1			1
Paraesarcophaga orchidea	♀				1			1	2
TOTAL SARCOPHAGIDs:		4	15	40	45	37	16	10	167
TOTAL FLIES:		78	423	1567	1333	686	56	17	4150

Table No. 4a. Number of flies trapped in different heights of Microwave tower in Jalpaiguri Town.

FAMILY	Species	Different heights of Microwave Tower.																TOTAL
		Ground level.		15m		23m		33m		40m		45m		50m		55m		
	Sex	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	
CALLIPHORIDAE	Chrysomya megacephala	597	65	2	1	3												668
	Chrysomya rufifacies	2	1	1		3												7
	Hemipyrellia ligurriens	8	5															13
	Hemipyrellia pulchra	1	1															2
	Lucilia cuprina	1																1
	TOTAL SEX:	609	72	3	1	6												691
MUSCIDAE	Musca domestica	15	12															27
	Musca sorbens	21	10															31
	Musca lucens	5																5
	Musca pattoni	4																4
	TOTAL SEX:	45	22															67
SARCOPHAGIDAE	Anthomydiae			8		1				1								
	Parasarcophaga knabi		4	2														6
	Parasarcophaga brevicornis	18	3	1						2				1		1		25
	Parasarcophaga ruficornis	2		1						1				2		2		6
	Parasarcophaga albiceps	3	1															4
	Parasarcophaga misera		1	1								1	1	2				6
	Boettcherisca peregrina			1														
	TOTAL SEX:	23	9	6						1 2		1	1	5				48
	GRAND TOTAL SEX:	677	103	9	1	6	6			1 2		1	1	5				806

Table No. 4b. Number of flies trapped in different heights of Microwave tower in Falakata Town.

Family	Species / Sex	Different heights of Microwave tower														Total
		Ground level		13m		25m		33m		40m		45m		50m		55m		
		♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	
Calliphorid	Chrysomya megacephala	42	10	4	1													57
	Total Sex:	42	10	4	1													57
Muscid	Musca domestica	203	81		1					1								286
	Musca sorbens	12	5															17
	Musca lucens	26	6	1														33
	Total Sex:	241	92	1	1					1								336
	Anthomydae			17		5		21				11						
Sarcophagid	Parasarcophaga misera	2										1		1				4
	Parasarcophaga albiceps	1	1															2
	Total Sex:	3	1									1		1				
		286	103	5	2					1		1		1				294 + 105 = 399

Chapter - II

SEASONAL DISTRIBUTION, DENSITY, PHOTOPHILIC BEHAVIOUR OF FLIES (CALLIPHORIDAE, MUSCIDAE AND SARCOPHAGIDAE) AND EFFICACY OF THEIR ATTRACTANTS.

Flies are well-known carriers of pathogenic micro-organisms responsible for various diseases of man and domesticated animals in urban areas where they come in close contact with human habitation.

The present work was undertaken in Jalpaiguri Town to find out the number of synanthropic flies, having appreciable danger index in the study area, their seasonal activity, hourly density, and their visit to food in sunshine and in shade. An effort was also made to study the efficacy of different baits as attractants for such flies. Jalpaiguri Town of the District of the same name was selected for the present study because of its moist and damp climate with an annual mean rainfall of nearly 400 mm.

The following is an account of work done in this subject in different parts of the world.

I. Resumé of work done on Seasonal distribution and density of flies :-

Occurrence of fly varies in a given locality in different seasons. Such variation was found dependant on geographical and climatic factors (Suenaga et al., 1964; Nuorteva, 1966b and Park, 1977). Fluctuation of fly population in tropical and semitropical zones showed bimodal peak of abundance (Suenaga, 1954; Kano et al., 1964; 1965; Sento

and Suenaga, 1970; Roy and Dasgupta, 1975; Sasaki and Nishijima, 1976; Das, 1980) but in the cooler countries like Finland (Nuorteva, 1958b) and New Zealand (Murray, 1956) unimodal peak occurred.

Suenage (1954), during his ecological investigation on flies in Sabae prefecture, Japan, found that flies in general exhibited bimodal peak of activity, one peak occuring in June and the other in September, and that there was a marked decrease in the population of flies in the intervening months. This, according to author, was partly due to the decrease in the number of flies and partly due to temporary cessation of breeding of flies. Such cessation of breeding seems to be the result of rapid decomposition of breeding media due to high temparature. The same author in his subsequent work (1956) on seasonal prevelence of Musca domestica vicina at Isahya, Japan, reported that flies showed signs of activity from the beginning of March, became very active from April to July; and peak of their abundance occurred in May. Fukuda (1960a) noted, on the basis of collected pupae of dominant species in Nagasaki prefecture, Japan, that Calliphora grahami, M. domestica vicina, Stomoxys calcitrans and Boettcheriscs perigrina showed unimodal peak of abundance which varied in the cases of different species. Population curves for Chrysomya albiceps and Lucilia sericata were

bimodal in desert and foot-hill zones of Uzbekistan, but were unimodal in the mountain zone (Sychevskaya, 1962). The author further pointed out that Calliphora vicina (=erythrocephala) showed bimodal curve of abundance in all the zones throughout the year, though the peak periods varied depending upon the decrease of mean temperature. Kano et al., (1964), while studying the seasonal occurrence of medically important flies in Ishigaki Island, Ryukyus, Japan, observed that flies in general exhibited bimodal seasonal prevalence curve. Bimodal curve of abundance of flies was also observed in Imperial Palace ground, Tokyo, Japan (Kano et al., 1965). Seato and Suenaga (1970), while studying the seasonal activity of flies at Matsuyama, Japan, reported three types of prevalence curves. The first type had two peaks, one higher peak in spring, and a smaller one in autumn; the second type had two peaks, a smaller one in spring and a larger one in autumn; the third type showed no noticeable peak. In Budapest, Hungary, C. vicina (=erythrocephala) and Muscina stabulans were very much active in spring and autumn and exhibited bimodal peak of abundance (Aradi and Mihalyi, 1971). In Siliguri, India, Chrysomya megacephala and C. rufifacies were very much active in summer and autumn and showed bimodal peak of abundance in May and September (Roy and Dasgupta, 1975). In Calcutta, (Das, 1980) Calliphorid flies showed bimodal peak of abundance in the months of March and December, and these flies were very active in winter and

in spring. Sarcophagid flies also exhibited bimodal peak of seasonal abundance in April and in November. The same author also observed that the difference in total number of trapped flies at different trapping sites (Zoological garden, Presidency College, Park Circus and Sinthi) in Calcutta depended on the quality and quantity of breeding media.

Fly population curve was more stable in rural areas than in the urban areas (Bruce and Knipling, 1936; Cushing and Parish, 1938; Lindquist, 1938; Deonier, 1942; Power and Melnick, 1945; Dicke and Eastwood, 1952; Schoof and Savage, 1955).

Sanitation and public health maintenance yielded results which influenced fly populatinn curve of urban areas, because the refuse and garbage depots of the city areas were the sources of increase of such population (Green, 1951; Green and Kane, 1954; Schoof et al., 1954; Siverley and Schoof, 1955; Shura-Bura et al., 1956, 1958; Nagy and Black, 1962 and Nuorteva, 1962). Fly population of an urban area depended not only on the output of breeding media in the city areas but also on the flies which were added to the existing city population originating from the refuse and garbage depots located not far from the city. This affected the population curve to a large extent (Bishopp and Laake, 1921; Lindquist et al., 1951; Quarterman et al., 1954a,b; Schoof, 1959;

Ogata, 1960; Macleod and Donnethy, 1960, '63; Nuorteva et al., 1964b and Mihalyi, 1967). Flies of the city of Kuopio, Finland and theseof the refuse depot located in Tiihottärenmaki was identical because the flies originating from the refuse depot entered the city, and the removal of the refuse depot resulted in a considerable decrease in the abundance of flies in the city (Nuorteva et al., 1964b). Norris (1965) showed that regular disposal of refuse and garbage of the city areas caused fluctuations in the fly population curve.

The presence of predator larvae like Muscina, Hydrotea and Ophyra caused damage to other developing fly larvae resulting in the changes of population curve (Thomson and Hammer, 1936). Nicholson (1948, 1950 and 1957) noted that intraspecific competition for food might also result in the decrease of number of developing adults. Nuorteva (1970) showed that Histerid beetles (Saprimus semistriatus, S. cuspidatus and S. aeneus), a predator of blowfly larvae, might cause decrease of blowfly population to a considerable extent. Nuorteva (1959) also found that some mammals and birds feeding on dead animals in the field become an important factor in controlling the blowfly population of an area.

Phormia terraenovae in the archipelago of the subarctic lake, Inarinjarvi, Finland (Nuorteva, 1966b) occurred in much lesser number in the island of lake Inarinjarvi during

the period when the species showed highest abundance in the shore village. This was possibly due to the existence of lower temperature and higher humidity in the islands and than in the shore village. Similar observations were made by Nuorteva and Räsänen (1968) in the mainland and in the islands of different sizes in the archipelago of the lake Kallavesi, Finland. There was a positive correlation between the area of the islands and the abundance of blowflies.

Stewart and Roessler (1942) failed to draw any correlation of fly population to temperature and humidity but Schoof and Savage (1955) showed that the climatic factors of an area alone could control the predominance of fly species. Suenaga et al., (1964) pointed out that the difference in the number of each fly species in its seasonal prevelance might be due to the change in climatic conditions and also to the quantity and quality of its brodding sources. This author also observed that heavy rains decreased the activity of adult flies and persistent heavy rains suppressed the breeding of flies, except for the Sarcophagids who were very little affected by rains. Nuorteva (1972) showed that temperature and humidity were factors correlated to the mean duration of period of development in the case of Cynomia mortuorum.

Change in climatic condition reduced fly population and resulted in its total absence during unfavourable period as was evident from the seasonal prevelence curve of Calliphora

lata and Aldrichina grahami in Osaka (Buei, 1959); Calliphora lata in Tokyo (Kano et al., 1965); Calliphora erecsipalpis in South Africa (Smit, 1951); Calliphora abifrontalis in Western Australia (Newman et al., 1930); Chrysomya megacephala, C. rufifacies and Lucilia sericina in Siliguri, India (Roy and Dasgupta, 1975) and Musca domestica vicina in Isahaya, Japan (Suenaga, 1956).

Calliphora stygia in Tokyo (Kano et al., 1964) and Cochliomyia hominivorax in Texas (Lindquist, 1938) showed low seasonal abundance, as these flies were adapted to cold climatic conditions. Flies adapted to tropical countries were found throughout the year in the warmer regions of their range, but were absent in winter in the cooler regions as was seen in the case of C. rufifacies in Australia (Gurney and Woodhill, 1926, Davies, 1929; Newman et al., 1930 and Fuller, 1934); Chrysomya albiceps in South Africa (Smit, 1951; Hepburn, 1943; Zumpt and Patterson, 1952); Boettcherisca peregrina and Hemipyrellia ligurriens in Tokyo, Japan (Kano et al., 1965) and Musca sorbens in Siliguri, India (Roy and Dasgupta, 1975).

Mihalyi (1967a) in his work on synanthropic flies of Hungary drew their abundance graph of seasonal distribution, through which he interpreted the number of generations a species was likely to produce in a year.

II. Resumé of work done on Photophilic behaviour of flies :-

It is known that the response of flies towards light varies from species to species and even in both sexes of the same species.

Graham-Smith (1916), Wardle (1930), and Green (1951) found that blowflies showed positive reaction to sunlight, but this reaction got temporarily reversed in females during oviposition.

Harker (1958) found that light intensity, during day time was an important environmental factor for locomotory activity of Musca domestica in England.

In Berlin, Kirchberg and Bakri (1960) oporated seven traps (baited with raw fish, fresh liver, ground meat, tinned dill-meat, tinned meat, tinned herring and human faeces) in sunshine as well as in shade and found that between 68.6% to 71.9% flies were caught in the traps placed in sunshine, and in a similar experiment in Finland, over 80% flies were caught in sunshine (Nuorteva, 1963).

Fukuda (1960a) trapped flies from three different localities (one at sunny front-yard of a farm-house, one in the forest near a village and one under the shade of a tree in the village) and observed that the numbers of individual species,

genus and family of flies were numerous in the trap under the tree followed by those in the forest and in sunny front-yard. It was also noted that Calliphora lata was numerous in all the three traps, Chrysomya megacephala being maximum in number in the trap placed in the sun, followed by those in the trap placed in the shade and in the forest. However, Lucilia ampullacea, Hemipyrellia ligurriens and Muscina stabulans were numerous in the forest traps and in the traps placed in the shade, while only a few were trapped in the sun.

Studies on the diurnal rhythms of the house-fly, Musca domestica, in a dry tropical ~~xx~~ environment in Nigeria (Parker, 1962) revealed that various diurnal rhythm such as movement in general, feeding, mating, ovipocition and emergence were virtually confined to the hours of day-light.

In Finland, Nuorteva (1963) trapped blowflies in different localities, and reported two groups of flies, one being heliophilic i.e., the flies who preferred to live in light (Phormia terraenovae, Lucilia richardsi, L. fuscipalpis, L. sericata, L. illustris and Calliphora genarum) and the other being scotophilic i.e., those who preferred to live in shade (Cynomyia mortuorum, Calliphora vicina [=erythrocephala] C. vomitoria and C. subalpina). He further noted that females of blowflies in general were more scotophilic than the

corresponding males and this scotophilism was probably connected with the tendency of the females to deposit eggs in shady places. The same author in his subsequent work (Nuorteva, 1965a,b) on blowflies in subarctic condition in Finland revealed that incidence of blowflies was determined not so much by the temperature itself but by the occurrence of sunshine. The highest peak of blowfly activity clearly occurred during short moments when cloud was absent. The activity of Helina binotata in different biota was regulated not only by temperature and humidity but also by light intensity (Nuorteva, 1965a). Nuorteva and Vesikari (1966) showed that Cynomyia mortuorum, with a low grade of heliophily (Nuorteva, 1963), commonly bred in the carcasses of arctic voles in their holes. These authors further pointed out that the tendency of this fly to visit carcasses of wild voles might result in possible transmission of disease germs from carcasses to man. In arctic conditions, Nuorteva and Hackman (1970) found that a delayed peak occurred in open field, as compared to one in a shady place, in case of Chyromyza costata, a Drosophilid fly. However a high degree of heliophilism was observed in Calliphoride in Ailigas hill, Northern Finland, where the flies showed greater abundance in sparse birch scrub fully exposed to sunshine near the timber line, than in the shady birch forest (Hedström and Nuorteva, 1971).

In Isahaya, Japan, Suenaga (1963) observed that light intensity solely controlled the activity of flies at temperature below 15°c and that the flies began their activity only when the light intensity reached 400 to 3000 lux.

In Calcutta, India, photophilic behaviour of flies was studied by Das (1980) who observed that Hemipyrellia ligurriens, Lucilia cuprina, Chrysomya megacephala, C. rufifacies, C. albiceps and L. sericata were scotophilic in nature but C. nigripes was heliophilic. This author also indicated that the females of blowflies were more scotophilic than the corresponding males which were more heliophilic.

III. Resume of work done on the efficacy of attractants for flies :-

Flies in general are filth-inhabiting and they frequently visit food of different kinds.

Carcasses as bait (fish, frog, snake, chicken and rat) were used for studying the breeding of flies in Japan (Suenaga, 1959c) and it was observed that the dominant fly species emerging from the carcasses were Lucilia illustris, Hemipyrellia ligurriens, L. sericata, L. ampullacea and Sarcophaga similis. It was also observed that the maximum number of flies emerged from the carcasses of rats, followed by flies from those of fish, snake, chicken and frog.

Kawai and Suenaga (1960) used fish baits in different grades of putrefaction (1, 2, 3, 5 and 7 days old) and found that one-day old fish bait was most effective for collecting flies, followed by 2, 3, 5 and 7 days old fish. Absolutely fresh fish was least attractive as a bait. These authors further observed that the fly associations on fish baits in different states of decomposition were roughly similar. Nuorteva (1965a) also collected flies by using tinned pork and beef in different grades of freshness as baits.

Five different types of baits (viz., cut-fish, pea-cheese, "soke-leese," "formalin fish" and fish powder) were used by Kawai (1962) for collecting flies in Japan, and he observed that maximum number of flies were trapped in fish-baited traps followed by those trapped with pea-cheese bait. Number of species in the pea-cheese trap was the greatest.

Seven different kinds of baits (raw fish, fresh liver, ground meat, tinned dill-meat, tinned meat, tinned herring and human faeces) were used by Nuorteva (1963) in Finland for collecting flies and he found that human faeces, raw fish, tinned meat and fresh liver were the best attractants for blowflies in Finland. This author in his subsequent work (1964b) on the zonal distribution of blowflies on Alligas hill used fresh liver, tinned meat and human faeces as baits and found that preferences for bait varied from species to species in Calliphorids but meat and human faeces were favoured

by maximum number of species. The greater attraction of Calliphorid and Sarcophagid flies towards decomposed meat and fish entrails was observed by Shinonaga (1965) on Mount Fuji, Japan. Similar observation on the preference or liking of different baits was also made in Budapest, Hungary (Mihalyi, 1967c) where different species of flies exhibited different preference to baits. Kano et al., (1964) used "sake dreg" and raw fish as baits for studying seasonal occurrence of flies in Ishigaki island in Japan and found that the peak of abundance of flies varied in the cases of two different baits, and that the percentages of males and females were more or less the same on "sake dregs", but females out-numbered males in fish-baited traps.

In Budapest, Hungary, Aradi and Mihalyi (1971) used meat, bread soaked in milk, and some seasonal ripe fruits for collecting flies and noted that the maximum number (81.2% of Lucilia sericata and Calliphora vicina) visited meat-baited trap followed by fruit baits (13.5% to 17.5%) and milk (1.3% to 5.5%), while M. stabulans showed greater preference for fruit baits (55.5%) than that of meat (30.7%) or milk (19.9%).

Fly species Lucilia caesar got easily attracted to faecal matter in Europe (Gregor and Povolny, 1958, '59, '60, '61; Tesohner, 1958, '59, '60, '61 and Havlik and Batova, 1960) but showed very little preference to faecal matters in Finland

(Nuorteva, 1963). Lucilia illustris was found to be a frequent visitor to faecal matter both in Berlin (Kirchberg, 1951) and in Finland (Nuorteva, 1963), while L. sericata visited faecal matter regularly in Finland (Nuorteva, 1963) but never in Greece (Kirchberg, 1961). Calliphora uralensis showed strong preference to faecal matters in Russia (Sukhova, 1952; Stackelberg, 1956 and Derbeneva-Ukhova, 1961, '62) and in Finland (Nuorteva, 1963). But in Finland Phormia terraenovae was quite common and abundant on faecal matter (Nuorteva, 1963)but the same species rarely visited faecal matter in Germany (Kirchberg, 1951; Teschner, 1958, '59, '61) or in Czechoslovakia (Gregor and Povolny, 1958; Havlik and Batova, 1960).

Different food habits of people of different regions might possibly determine the efficacy of stool as fly attractant (Nuorteva, 1963). The nature of food consumed by sheep affected to a great extent the value of faecal materials as a source of food for Lucilia cuprina (Webber, 1958). Similar observation was made by Ascher (1958) on the attraction of Muscina vicina to natural breeding media.

In India, Das (1980), used jackfruit, ripe mango, molasses, fresh fish and fresh meat for trapping flies and noted that maximum number of flies were trapped in jackfruit baited trap followed by ripe mango, fresh fish, fresh meat and molasses. The author also noted that greater number of female

blowflies were trapped in proteinaceous baits, but the males of blowflies were greater in number in non-proteinaceous baits.

MATERIAL AND METHOD

I. Seasonal distribution and density of flies :-

To study the seasonal distribution and density of fly population in Jalpaiguri Town* simultaneous trappings were undertaken throughout the year 1974. The traps (of the type described in chapter IV) were baited with 250 gm of raw fish and were operated for seven to eight hours on all the trapping days.

Trappings were made at three different places of the town. These trapping sites were as follows -

(a) A trap was placed at the locality called New Town in the compound of the house of a well known resident of this locality. The trapping ground was damp due to accumulation of water at certain places. Herbs and trees were present in the compound surrounding the house. The trap was exposed to sun-light and air from all sides.

(b) A trap was placed inside the compound of Jalpaiguri Fire Brigade station. The ground on which the trap was placed was low-land, but devoid of any permanent vegetation except for the grass. Constant availability of sun-light and air throughout the day was ensured from all sides.

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*A brief description about the town is given in page No. 10.

(c) A trap was placed by the side of a pond in the compound of a husking mill at Siriatala. The place is surrounded by paddy fields and marshy land. The trap was exposed to sun-light and air from all sides.

As a precautionary measure against intruding animals the baits placed in all the three localities were protected by a wire-net cover. This cover protecting the bait was tied firmly to the vertical iron foot-rest of the trap. Some extra weight was placed over the trap to keep it in position.

Trapping was made twice every month. Each trapping period was of five days' duration. Baits were renewed every two days in order to maintain its efficacy and flies were collected at the end of each trapping period.

Since the trap in different localities of an urban area gets disturbed for various reasons beyond human control, it was not found desirable to rely on the absolute number of flies caught in a given area in making seasonal curve of population. Therefore, following the example of Mihalyi (1967c), absolute numbers of flies as well as their densities were considered in making population curves and for interpreting the number of generations a species is likely to produce in a year, keeping in mind the fact that the generations were partly overlapping after the second one. The density was calculated by dividing the absolute numbers of a fly visiting a particular

trap by the known length of time to which the traps were exposed. Thus was obtained the average number of flies visiting a single-trap, which in its turn indicated the density of the species in question.

II. Photophilic behaviour :-

Three traps were simultaneously operated at three different sites in order to obtain data on the photophilic behaviour of different species of flies. The traps were as follows -

(a) Trap I. This was placed in an open field covered mostly by grass and surrounded by residential buildings. The trap was placed at a distance of 200 m from trap II and was exposed to sun-light and air throughout the day.

(b) Trap II. This was placed under a jackfruit tree. The area was surrounded by a good number of coconut trees, mango trees, jackfruit and other trees. The trap was neither exposed to full sun-light nor it was placed in complete shade. This condition of the site is described as 'canopy.'

(c) Trap III. This was placed beneath an open tin-shade at a distance of approximately 150 m from trap I and 100 m from trap II. As the shade was open on all the

sides, the trap was fully aerated but was completely in shade from morning till sunset.

III. Efficacy of the attractants :-

To ascertain the efficacy of the attractants used as bait, trappings were made in an open field (120 m X 60 m) situated in the north-eastern side of the Fire Brigade compound with eleven different baits (viz., fish, meat, rotten egg, cow dung, human faeces, molassoo, decomposed mixture of mustard oil flake - cow dung, mango, jackfruit, pineapple and banana) as attractants (see table No. 5).

Eleven traps with different baits (250 gm of each type) as attractants were placed approximately three meters apart from each other with a view to study the influence of different baits on the flies. The traps were operated from sunrise to sunset. The trapping area was covered with grasses and was surrounded by residential buildings, Government warehouses, Municipal market and the Fire Brigade compound. Traps were all exposed to sun-light and air from all directions.

OBSERVATION

I. Seasonal distribution and density of flies :-

The total number of flies trapped during the period of study i.e., from January to December 1974 were 58, 254 belonging to three families (viz., Calliphoridae, Muscidae and Sarcophagidae), comprising of 15 genera and 34 species. Seasonal occurrence and densities of these flies in different months of 1974 (which was the actual period of trapping for the purpose of this study), is shown in figures 2 to 42, and in table no. 1 and 3. The traditional six seasons* of the Indian calender is considered in the table.

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* 1). Hot season i.e., Summer (called in Bengali Language Grishma) extending between 15th April to 14th June approximately.

2). Rainy season (called in Bengali Language Varsha) extending between 15th June to 14th August approximately.

3) Autumn season (called in Bengali Language Sharat) extending between 15th August to 14th October approximately.

4). Season of Dew (called in Bengali Language Hemanta) extending between 15th October to 14th December approximately.

5). Season of cold days i.e., Winter (called in Bengali Language Shest) extending between 15th December to 14th February approximately.

6). Spring season (called in Bengali Language Vasanta) extending between 15th February to 14th April approximately.

Seasonal prevelence of flies showed that maximum number of flies were trapped in summer, numbering 12529 or 32.75% of the total catch of the year, (of which females were 10664 or 85.11% and males were 1865 or 14.88%); followed by autumn, numbering 9018 or 23.57% of the total catch of the year, (of which females were 7198 or 79.81% and males were 1820 or 20.18%); rainy season, numbering 8575 or 22.41% of the total catch of the year, (of which females were 7288 or 84.99% and males were 1287 or 15.00%); Season of Dew i.e., Hemanta numbering 3911 or 10.22% of the total catch of the year (of which females were 3343 or 85.47% and males were 568 or 14.52%); spring numbering 2967 or 7.75% of the total catch of the year (of which females were 2605 or 87.79% and males were 362 or 12.20%) and winter numbering 1254 or 3.27% of the total catch of the year (of which females were 1082 or 86.28% and males were 172 or 13.71%).

Calliphorid and Muscid flies were trapped in maximum number in summer while Sarcophagide were trapped in maximum numbers in spring (see table No. 2).

Calliphorid flies were the most abundant, numbering 32,088 or 83.8[illegible]% of the total catch, of which females were 26,807 or 83.54% and males were 5,281 or 16.45%. The Calliphorid fly population consisted of 4 genera and 8 species. Chrysomya megacephala was the most commonly and abundantly

found species (numbering 30,013, of which females were 25,127 and males were 4,886) with mean seasonal density 11.3 (average hourly density of females being 9.23 and that of males being 1.80); followed by Chrysomya rufifacies (numbering 778, consisting of 616 females and 162 males) with mean seasonal density 0.28 (average hourly density of females being 0.23 and that of males being 0.07); Hemipyrellia ligurriens (numbering 876 consisting of 716 female and 160 male) with mean ~~ff~~ seasonal density 0.31 (average hourly density of females being 0.26 and that of males being 0.07); Lucilia cuprina (numbering 238 consisting of 204 females and 34 males) with mean seasonal density 0.13 (average hourly density of females being 0.11 and that of males being 0.02); and Hemipyrellia pulchra (numbering 170 consisting of 134 females and 36 males) with mean seasonal density 0.08 (average hourly density of females being 0.06 and that of males being 0.03).

Muscid flies were the second largest group after Calliphorida and numbered 4613 or 12.05% of the total catch (consisting of 4189 females and 424 males). The Muscid fly population comprised of 5 genera and 14 species. Musca domestica was the most dominant fly in this family (numbering 2,866 consisting of 2,601 females and 265 males) with mean seasonal density 0.98 (average hourly density of females being 0.89 and that of males being 0.20); followed by M.lucens

(numbering 567, consisting of 496 females and 71 males) with mean seasonal density 0.24 (average hourly density of females being 0.21 and that of males being 0.05); Ophyra chaloogaster (numbering 450, consisting of 440 females and 10 males) with mean seasonal density 0.17 (average hourly density of females being 0.16 and that of males being 0.03); M. sorbens (numbering 258, consisting of 205 females and 53 males) with mean seasonal density 0.08 (average hourly density of females being 0.06 and that of males being 0.02); M. ventrosa (numbering 101, consisting of 96 females and 5 males) with mean seasonal density 0.08 (average hourly density of females being 0.08 and that of males being 0.01); M. nattoni (numbering 91, consisting of 75 females and 16 males) with mean seasonal density 0.04 (average hourly density of females being 0.04 and that of males being 0.02).

Sarcophagid flies formed the smallest bulk among the total trapped flies (numbering 1,533, consisting of 1184 females and 369 males) and comprised of 6 genera and 12 species. Parasarcophaga brevicornis was trapped in highest number (357, consisting of 342 females and 15 males) among all Sarcophagid flies, with mean seasonal density 0.12 (average hourly density of females being 0.11 and that of males being 0.02); followed by Parasarcophaga albiceps (numbering 340, consisting of 271 females and 69 males) with mean seasonal density 0.11 (average hourly density of females being 0.09

and that of males being 0.03); Parasarcophaga knabi (numbering 274, consisting of 191 females and 83 males) with mean seasonal density 0.09 (average hourly density of females being 0.07 and that of males being 0.03); Boettcherisca peregrina (numbering 226, consisting of 126 females and 100 males) with mean seasonal density 0.07 (average hourly density of females being 0.05 and that of males being 0.03); Parasarcophaga ruficornis (numbering 145, consisting of 134 females and 11 males) with mean seasonal density 0.06 (average hourly density of females being 0.06 and that of males being 0.04); Parasarcophaga misera (numbering 132, consisting of 92 females and 40 males) with mean seasonal density 0.04 (average hourly density of females being 0.03 and that of males being 0.02); and Parasarcophaga orchidea (numbering 39, consisting of 18 females and 21 males) with mean seasonal density 0.02 (average hourly density of both females and males being 0.01).

In addition to above the following specimens were also trapped in small numbers (see also table No. 1):-

Lucilia sericata (numbered 10, consisting of 7 females and 3 males), Calliphora pattoni (numbered 1, consisting of a single female), Musca fasciata (numbered 184, all females), Musca crassirostris (numbered 25, consisting of 24 females and 1 male), Ophyra leucostoma (numbered

16, consisting of 14 females and 2 males), Ophyra capensis (numbered 15, all females), Ophyra nigra (numbered 13, all females), Stomoxis calcitrans (numbered 6, all females), Synthesomyia nudisetta (numbered 4, all females), Dichaetomyia sp (numbered 17, consisting of 16 females and 1 male), Semiorwhitea krameri (numbered 24, consisting of 8 females and 16 males), Parasarcophaga hirtipes (numbered 9, all males), Harpagophalla kempi (numbered 3, all males), Sarcosolomonia crinita (numbered 2, all males), and Iranihiadia martellata (numbered 2, all females).

Maximum number of flies in the present experiment were trapped in the months of May and September. Calliphoride constituted the main bulk of flies in all months of the year. Females of species outnumbered the males in all the catches of the year, except in cases of P. orchidea, P. hirtipes, S. krameri, S. crinita and H. kempi, where the number of males were more than the females. On the other hand, only the females were trapped in cases of L. ampullacea, C. pattoni, M. fasciata, O. nigra, O. capensis and S. calcitrans. Percentage of males were comparatively higher in autumn than in other seasons of the year. C. megacephala, C. rufifacies, H. ligurriens, P. brevicornis, P. albiceps, P. knabi, B. perigrina, P. rufi-cornis, M. domestica, O. chalcogaster and M. sorbens were trapped in all months of the year.

Excepting H. ligurriens and M. fasciata, Calliphorid and Muscid flies in general exhibited bimodal peak of seasonal abundance while Sarcophagids showed unimodal peak of abundance with a tendency to trimodality.

II. Photophilic behaviour :-

Total number of flies belonging to three families (viz., Calliphoridae, Muscidae and Sarcophagidae) caught in this experiment was 964, which consisted of 7 genera and 19 species (see Table No. 4).

Calliphorid flies were most abundant numbering 783 (consisting of 693 females and 90 males) or 81.22% of the total catch and comprised of two genera and four species. 55.42% of the total catch of Calliphorids were trapped in sunny area, 51.41% in 'canopy' and 13.15% in complete shade.

Chrysomya megacephala :

This was the most dominant species of the family Calliphoridae and dominated the catches of all the localities. 59.34% of the total catch of C. megacephala were trapped in sunny area (of which 53.06% were females and 6.27% were males); 28.53% in 'canopy' (of which 26.24% were females and 2.28% were males); and 12.12% in complete shade (of which females were 11.55% and males were 0.57%).

Hemigyrellia ligurriens :

8.95% of the total catch of H. ligurriens were trapped in sunny area (of which 7.46% were females and 1.49% were males); 65.67% in 'canopy' (of which 47.76% were females and 17.91% were males) and 25.37% in complete shade (of which females were 14.92% and males were 10.44%).

Chrysomya rufifacies :

85.71% of the total catch of C. rufifacies were trapped in sunny area (of which females were 57.14% and males were 28.57%); 7.14% in 'canopy' (all males) and another 7.14% in complete shade (all females).

Muscid flies numbering 142 (consisting of 123 females and 19 males) or 14.73% of the total catch consisted of two genera and seven species. 38.02% of the total catch of Muscids were trapped in complete shade, 35.91% in sunny area and 26.05% in 'canopy'.

Musca sorbens :

This was the most dominant species of the family Muscidae and was found in the catches of all the localities. 31.34% of the total catch of M. sorbens were trapped in sunny area (of which females were 25.37% and males were 5.97%); 34.32% in 'canopy' and another 34.32% were trapped in complete

shade (of which females were 28.35% and males were 5.97% in both the cases).

Musca domestica :

40.38% of the total catch of M. domestica were trapped in sunny area (of which females were 34.61% and males were 5.86%); 17.30% in 'canopy' (of which females were 15.38% and males were 1.92%); and 42.30% in complete shade (of which females were 40.38% and males were 1.92%).

Musca lucens :

This species was absent in sunny area, but 20.00% of the total catch of M. lucens were trapped in 'canopy' (all females); and 80.00% in complete shade (of which females were 70.00% and males were 10.00%).

Musca ventrosa :

71.42% of the total catch of M. ventrosa were trapped in sunny area (all females); 28.57% in 'canopy' (all females); and this was absent in complete shade.

Musca pattoni :

50.00% of the total catch of M. pattoni were trapped in sunny area (all females); 25.00% in 'canopy' and another 25.00% were trapped in complete shade (all females in both the places).

Sarcophagid flies numbering 39 (consisting of 36 females and 3 males) or 4.04% of the total catch consisted of 3 genera and 8 species. 38.46% of the total catch of Sarcophagids were trapped in sunny area, 35.89% in 'canopy' and 25.64% in complete shade.

Paresarcophaga brevicornis :

This was the most dominant species of the family Sarcophagidae. 50.00% of the total catch of P. brevicornis were trapped in sunny area; 16.66% in 'canopy' and 33.33% in complete shade. In all the three areas only the female flies were trapped.

Paresarcophaga knabi :

57.17% of the total catch of P. knabi were trapped in sunny area (all females); 28.57% in 'canopy' (of which females and males were 14.28%); and 14.28% in complete shade (all females).

Paresarcophaga albiceps :

33.33% of the total catch of P. albiceps were trapped in all the three areas and the trapped flies were all females.

Paresarcophaga ruficornis :

This species was absent in sunny area, but 60.00% of the total catch of P. ruficornis were trapped in 'canopy' (all

females) and 40.00% in complete shade (all females).

Boettcheriesa perigrina :

This species was trapped only in 'canopy' (of which females were 75.00% and males were 25.00%).

Some flies viz., H. pulchra, M. crassirostris, O. chalcogaster, P. orchidea and P. misera were trapped in very small numbers from only one or two areas, and as such no indication regarding their photophilic behaviour could be ascertained.

III. Efficacy of the attractants :-

Eleven different baits viz., (1) banana, (2) pineapple, (3) mango, (4) jackfruit, (5) mustard oil flake - cow dung mixture, (6) molasses, (7) human faeces, (8) cow dung, (9) rotten egg, (10) meat and (11) fish were used which yielded a total catch of 1513 flies belonging to the families Calliphoridae, Muscidae and Sarcophagidae, consisting of 11 genera and 23 species (see Table no. 5).

(1) Banana bait :

Total number of flies trapped with banana as bait was 32 or 2.08% of the total catch and consisted of three genera and six species. Dominant species of the catch was Musca

sorbens (35.29% female and 64.70% male) and Chrysomya megacephala (57.14% female and 42.85% male).

(2) Pineapple bait :

Total number of flies trapped with pineapple as bait was 42 or 2.73% of the total catch and consisted of three genera and eight species. C.megacephala (61.53% female and 38.46% male), M. domestica (70.00% female and 30.00% male), M. lucens (57.14% female and 42.85% male) and M. sorbens (all females) were trapped in considerable numbers, while the number of other species was too small.

(3) Mango bait :

Total number of flies trapped with mango as bait was 232, constituting 15.11% of the total catch and consisted of four genera and ten species. M. sorbens (46.66% female and 53.33% male), C. megacephala (55.35% female and 44.64% male), M. domestica (84.00% female and 16.00% male), M. lucens (27.58% female and 72.41% male), M. pattoni (57.14% female and 42.85% male) and M. grassirostris (all females) were trapped in good numbers. Number of trapped Sarcophagid flies were negligible.

(4) Jackfruit bait :

Total number of flies trapped in jackfruit baited trap was 69 or 4.49% of the total catch and consisted of three genera

and ten species. Species like C. megacephala (54.54% female and 45.45% male), M. lucens (73.33% female and 26.66% male), M. domestica (76.92% female and 23.07% male) M. sorbens (all females) and M. pattoni (all females) dominated the catch.

(5) Mustard oil flake - cow dung mixture :

Total number of flies trapped with mustard oil flake-cow dung mixture as bait was 133 or 8.66% of the total catch and consisted of four genera and ten species. M. sorbens (53.75% female and 46.25% female), M. pattoni (84.61% female and 15.38% male), M. domestica (26.08% female and 73.91% male) and M. lucens (71.42% female and 28.57% male) were trapped in considerable numbers and the number of other six species were very insignificant.

(6) Molasses bait :

Total number of flies trapped in molasses - baited trap was 15 or 0.97% of the total catch, which consisted of three genera and six species. Excepting M. sorbens (71.42% female and 28.57% male) number of other five species were negligible.

(7) Human faeces bait :

Total number of flies trapped with human faeces as bait was 34 or 2.21% of the total catch and comprised of five

genera and nine species. Only H. pulchra (88.88% female and 11.11% male) and M. lucens (91.66% female and 8.33% male) were trapped in considerable numbers and the numbers of remaining species were very small and inadequate for the purpose of comment.

(8) Cow dung bait :

Total number of flies trapped in cow dung-baited trap was 30 or 1.95% of the total catch and consisted of six genera and nine species. H. pulchra (all females), M. lucens (80.00% female and 20.00% male) and P. albiceps (80.00% female and 20.00% male) were trapped in significant numbers while the number of other six species were less than four.

(9) Rotten egg bait :

Total number of flies trapped with rotten egg as bait was 86 or 5.60% of the total catch, consisting of eight genera and fourteen species. O. megacephala (all females), L. cuprina (83.33% female and 16.66% male), M. sorbens (93.33% female and 6.66% male), M. domestica (all females), P. misera (66.66% female and 33.33% male) and P. albiceps (50.00% female and 50.00% male) were trapped in considerable

numbers. Number of remaining eight species was very small.

(10) Meat bait :

Total number of flies trapped with meat as bait, was 29 or 1.88% of the total catch which consisted of five genera and nine species. C. megacephala (85.71% female and 14.28% male), M. domestica (all females), P. knabi (40.00% female and 60.00% male) and P. albiceps (all females) were trapped in considerable numbers and the rest were very insignificant in number.

(11) Fish bait :

Total number of flies trapped with fish as bait was 833 or 54.26% of the total catch and consisted of eleven genera and seventeen species. Species like C. megacephala (91.62% female and 8.37% male), M. sorbens (76.59% female and 23.40% male), O. chalcogaster (all females), M. domestica (87.50% female and 12.50% male), P. bravicornis (95.23% female and 4.76% male), P. knabi (69.23% female and 30.76% male) and H. ligurriens (81.81% female and 18.18% male) were trapped in good numbers while the number of remaining ten species were in-significant for any consideration.

Largest number of flies trapped in this experiment belonged to family Calliphoridae, forming 54.00% of the total

catch. Calliphorid flies in general exhibited maximum liking for fish bait (82.50%) followed by those for fruit bait and rotten egg bait. Other baits did not attract these flies much. Muscid flies constituted the second largest bulk (37.98%) of the total catch. Muscids were mostly attracted to fruit baits (29.33%) followed by mustard oil flake - cow dung mixture bait and fish bait. Other baits did not attract these flies much, and Sarcophagids constituted 8.01% of the total catch. Most favourable bait for Sarcophagid flies were fish (43.90%) followed by rotten egg bait, and meat bait. Other baits did not attract these flies much.

DISCUSSION

I. Seasonal distribution and density of flies :-

Total fly population of Jalpaiguri Town mainly consisted of three families viz., Calliphoridae, Muscidae and Sarcophagidae and resembled clearly the fly fauna of Siliguri City (26°44'N and 88°26'E; 119 m above mean sea level), India (Roy and Dasgupta, 1975). Climatic condition of these two places are not however identical. Mean rainfall, temperature and humidity for Jalpaiguri Town are 356.81 mm, 23.74°c and 76.15% respectively and those for Siliguri City are 309.4 mm, 22.73°c and 72.28% respectively. Jalpaiguri Municipal area has much more vegetation, than in Siliguri and there are sewage and garbage dumps situated in the vicinity of the town.

Inspite of the climatological disparities, the two places exhibit similarities in the seasonal behaviour of flies. These are as follows -

(1) Twenty-five species (out of 34 species in Jalpaiguri and 30 species in Siliguri) were common to both the places (see chart I).

(2) Calliphorids formed the main bulk of the fly population followed by Muscids and the seasonal occurrence of both the families exhibited bimodal peak.

(3) Chrysomya megacephala and Musca domestica were the most dominant species of the families Calliphoridae and Muscidae.

(4) C. megacephala, Hemipyrellia ligurriens, M. domestica, M. sorbens and Boettcherisca peregrina were caught throughout the year and were noxious.

(5) Sarcophagid flies exhibited unimodal peak of abundance with a tendency towards trimodality.

(6) C. megacephala, C. rufifacies, Lucilia cuprina, M. domestica, M. sorbens and Ophyra chalcogaster showed bimodal peak of abundance.

(7) Females were much more in number than the males in both the places.

Notwithstanding these similarities the following dissimilarities in the yearly population of the two places were also noted :-

(1) In Jalpaiguri Town H. ligurriens showed trimodal peak (March, May and August) of abundance in contrast to bimodal peak with a tendency to trimodality in Siliguri City (July and September).

(2) M. lucens showed bimodal peak in May and September in Jalpaiguri Town whereas the same fly formed an unimodal peak (September) in Siliguri City.

(3) Boettcherisca perigrina exhibited trimodal peak (March, July and September) in Jalpaiguri Town against the unimodal peak (December) in Siliguri City.

(4) C. rufifacies, Parasarcophaga brevicornis, P. albiceps, P. knabi and Ophyra chalcogaster were trapped in all months of the year in Jalpaiguri Town only.

(5) Calliphora nattoni, Lucilia sericata and L. ampullacea have been found in the yearly catch of Jalpaiguri Town.

Roy and Dasgupta (1975) stated that fly population of Siliguri City, resembled the fly population of southern Japanese island of Ishigaki (Kano et al., 1964). When a comparison between the fly fauna of Jalpaiguri Town and Ishigaki island was made, it was revealed that the fauna of Jalpaiguri resembled the fauna of Ishigaki island in much more details. Apart from the four cases of similarities* between the fauna of Siliguri City and Ishigaki island (Roy and Dasgupta, 1975).

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*(I) Sixteen species were identical, (II) C. megacephala was the most dominant species followed by M. domestica and Sarcophaga misera, (III) C. megacephala, M. domestica and S. perigrina were found throughout the year and were noxious and (IV) Sarcophagids showed unimodal peak of seasonal prevelence.

The fauna of Jalpaiguri Town showed the following additional similarities with that of Ishigaki island, Japan.

(1) Boettcheriesa perigrina exhibited trimodal peak of abundance.

(2) Chrysomya megacephala showed bimodal peak in annual prevelence.

(3) Musca domestica and M. sorbens showed bimodal peak of abundance.

(4) Hemipyrellia ligurriens exhibited trimodal peak of yearly prevelence.

Comparison of work of Das (1980) with the result of present study shows that (i) four species of Calliphorids and nine species of Sarcophagids (out of 8 species of Calliphorids and 12 species of Sarcophagids in Jalpaiguri and 7 species of Calliphorids and 12 species of Sarcophagids in Calcutta) were common to both the places; (ii) C. megacephala, C. rufifacies, L. cuprina and P. misera exhibited bimodal seasonal abundance curve in both the places; (iii) H. ligurriens, P. ruficornis and P. bevicornis showed bimodal seasonal prevelence curve in Calcutta in contrast to trimodal seasonal prevelance curve in Jalpaiguri and (iv) peaks of abundance occurred in March and September in Calcutta whereas maximum

abundance in Jalpaiguri was noted in May and September. Early abundance peak (March) in Calcutta was possibly due to higher temperature during March.

The seasonal prevelence of flies in the study area revealed some interesting points. Flies as a whole exhibited a bimodal peak of prevelence in May and September with appreciable decrease in number in the intervening months. After September, number of flies decreased steadily due to gradual fall in temperature during winter months and increased slowly from March after one or two showers (2 cm) when the temperature rose again above (20°c). Decrease in the number of flies in the month of June, July and August could be correlated to the increase in mean relative humidity and rainfall. Heavy rains not only hindered the activity of adult flies and suppressed their breeding (Suenaga, et al., 1964) but also drowned a large number of fly larvae due to stagnation of rain water on the soil and subsoil surfaces (Nuorteva, 1972). According to Nuorteva (1972) rise of temperature accelarated the development of C. mortuorum, and increase in relative humidity retarded the development of the same fly. The number of flies in all the cases decreased during the rains (June to August) and the fall in number was very sharp in the case of Muscids, less so in Calliphorids and very little in Sarcophagids. That the breeding, development and activity of Sarcophagid flies are little affected by

rain (Suenaga et al., 1964) seems to be true for Siliguri-Jalpaiguri area also. Calliphorid flies showed a steady decrease in number from June to August but dominated the catch during the period. This is due to the fact that their larvae are able to float on the surface of water with the aid of air - bubble when the surroundings are flooded (Kawai, 1963). The sharp decrease in the number of Muscoid flies during the months of rains is possibly due to the inability of the larvae of Muscoid flies to cope with stagnant water and also to their inability to breed and remain active during the rains.

Density graphs on seasonal abundance showed that the number of generations produced in a year varied from species to species and that the abundance of a species depended not only on the number of generations produced in a year but also on the eco-climatic conditions of the study area. Though Hemipyrellia pulchra, Musca lucens, Paramacrophaga brevicornis and P. ruficornis produced atleast six generation in a year their abundance was less than the abundance of Chrysomya megacephala, C. rufifacies, M. domestica etc , which produced three to four generation in a year.

II. Photophilic behaviour :

Considering the photophilic behaviour of flies Nuorteva (1963) termed these species of flies as heliophilic who prefer to live in light and scotophilic to those who prefer to live in shade. Flies of Jalpaiguri Town, in addition to heliophilic (viz., Chrysomya megacephala, C. rufifacies, Musca ventrosa, M. pattoni, Parasarcophaga knabi, P. brevicornis and Seniorwhitea krameri) and scotophilic (viz., Hemipyrellia ligurriens, M. lucens and P. ruficornis) species include an additional type of flies (viz., M. domestica, M. sorbens and P. albiceps) which are neither heliophilic nor scotophilic. This third group of flies occur more or less equally in light and in shade.

Photophilic behaviour of some flies of Jalpaiguri Town viz., C. megacephala, H. ligurriens, M. domestica and B. perigrina revealed similarities with their counterparts in Nagasaki, Japan (Fukuda, 1960a). In both the places H. ligurriens, M. domestica and B. perigrina were trapped in maximum numbers from the trap in 'canopy', though C. megacephala was in abundance in sunny areas. However, P. albiceps in Nagasaki, was trapped in maximum number from the trap in 'canopy', but the same species in the study area is equally abundant in the sun, in 'canopy' and in shade.

Difference in photophilic behaviour between the sexes was noticed in the case of Lucilia caesar, L. illustris and C. megacephala in England (Macleod and Donnelly, 1962) and those of L. caesar and L. illustris in Finland (Nuorteva, 1963). Similar observation have been made in Jalpaiguri area also. For example, males of C. rufifacies and M. domestica were found to be more heliophilic than their females and the females of H. ligurriens and M. lucens were more heliophilic than the corresponding males.

Nuorteva (1963) noticed that the heliophilic species were more synanthropic than the scotophilic species of Finland. In the present investigation C. megacephala, C. rufifacies, M. ventrosa, M. pattoni, P. knabi, S. krameri, H. ligurriens and M. sorbens were found more heliophilic than all other synanthropic flies. The finding of Nuorteva (1963) that females in general were more scotophilic than males could not be corroborated in the present study. The females only of some species showed preference to shade.

It is also revealed from the present study that some species of flies are heliophilic and some are scotophilic. So, in order to obtain all species of flies in a locality for study it is desirable to place traps in sun-light as well as in shade.

III. Efficacy of the attractants :

The present study revealed that flies in general were trapped in far greater number in fish-baited traps than in the traps baited with other proteinaceous or fruit baits (see Table No. 5).

In proteinaceous baits percentage of females were much higher than the males whereas in fruit baits variation in percentage of males and females was negligible. Barton-Browne (1958) observed that the females required protein food for maturation of their ovary, and Mamal (1958) noticed that females of many Calliphorid flies would only mate when they got sufficient protein. Our present study also reveals that females visit protein bait more than any non-proteinaceous bait. Visit to the proteinaceous baits by higher percentage of females of Calliphorids and Sarcophagids and to the fruit or mixture of cow-dung-mustard oil flake bait by Muscids were noticed. Visit to the protein bait by a few males of flies may be due to an endogenous drive for mating, whereas to the fruit bait both male and female mostly came for feeding purpose.

Present study further revealed that Calliphorid and Sarcophagid flies in general, preferred fish bait much more than the non-proteinaceous baits. On the other hand Muscids exhibited preference for non-protein baits like mixture of cow dung -mustard oil flake and mango fruit bait.

SUMMARY

(1) Twenty-five species of flies are common to Jalpaiguri Town and Siliguri City, and the flies show bimodal peak of abundance, one peak in May and other in September, in both the places.

(2) Four species of Calliphorids and nine species of Sarcophagids are common to Jalpaiguri and Caloutta. Peak months in Jalpaiguri are May and September, but in Caloutta the peak months are March and September. Early peak (i.e., in March) in Caloutta is possibly due to existence of higher temperature.

(3) Resemblances are also found between the fly fauna of Jalpaiguri Town and the fly fauna of Ishigaki island, southern Japan.

(4) Calliphorid and Muscid flies show bimodal and Sarcophagid flies show unimodal peak of abundance with a tendency to trimodality.

(5) C. megacephala, C. rufifacies, H. ligurriens, P. brevicornis, P. albiceps, P. knabi, B. perigrina, P. rufi-cornis, M. domestica, O. chalcogaster and M. sorbens are available in all months of the year.

(6) Number of Muscid flies decrease sharply during rains. Calliphorids are less affected by rains while Sarco-phagids are very little affected.

(7) In addition to heliophilic and scotophilic species the fly fauna of Jalpaiguri is found for the first time now as having an additional group of flies which are more or less equally available in the sun as well as in the shade.

(8) Males of C. rufifacies and M. domestica are more heliophilic than their females while females of H. ligurriens and M. lucens are more heliophilic than their males.

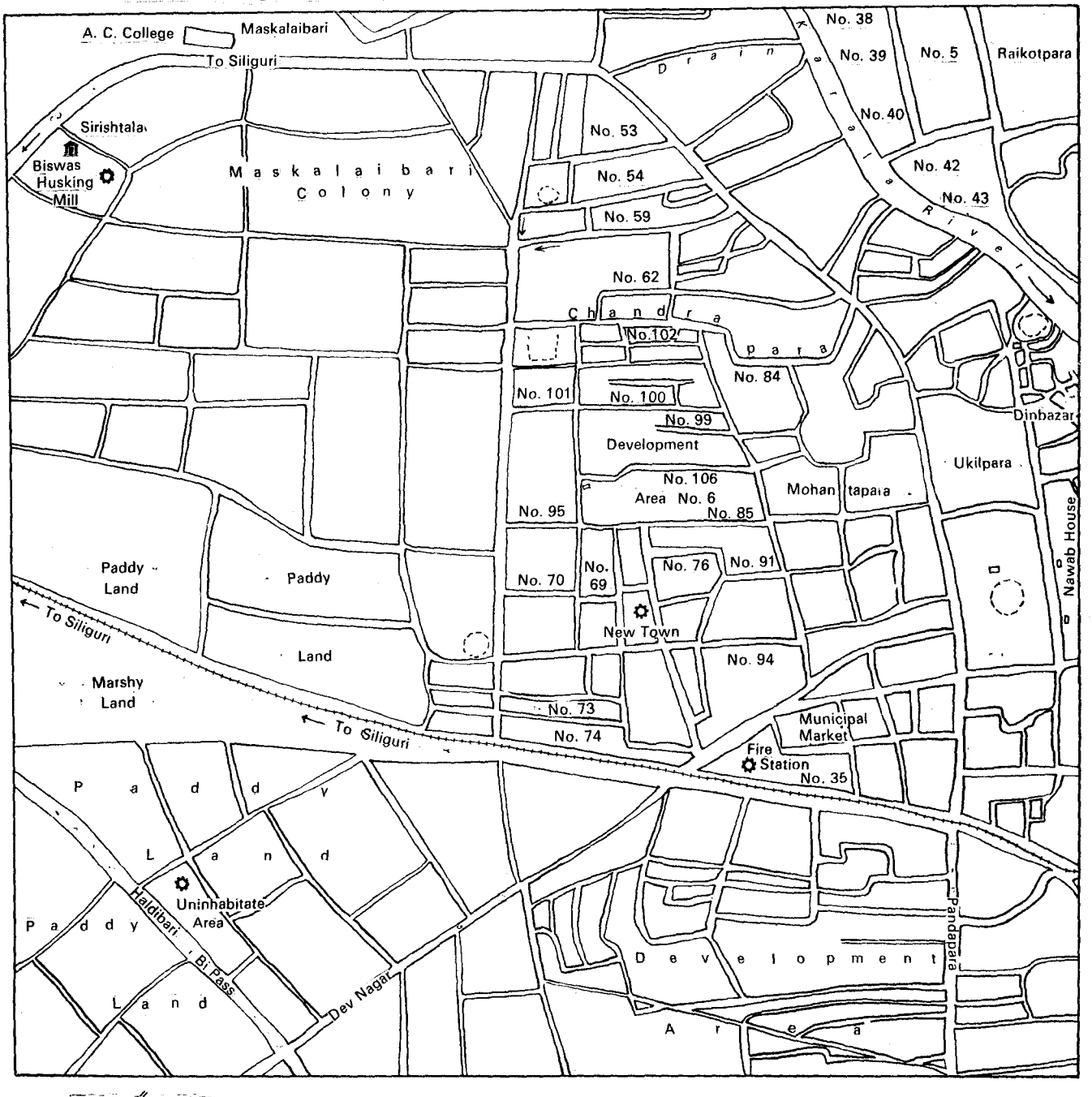
(9) Flies in general are much more attracted to fish-bait than to any other proteinaceous and non-proteinaceous bait.

(10) In proteinaceous baits percentages of females are higher than in the case of males.

(11) Calliphorids and Sarcophagids visit proteinaceous baits more than the Muscids who are attracted more to fruit and to mustard oil flake.

FIGURES AND TABLES

MAP OF JALPAIGURI TOWN :— WITH ADJOINING AREA



SCALE 8″ = 1 MILE

Trapping Sites ✿

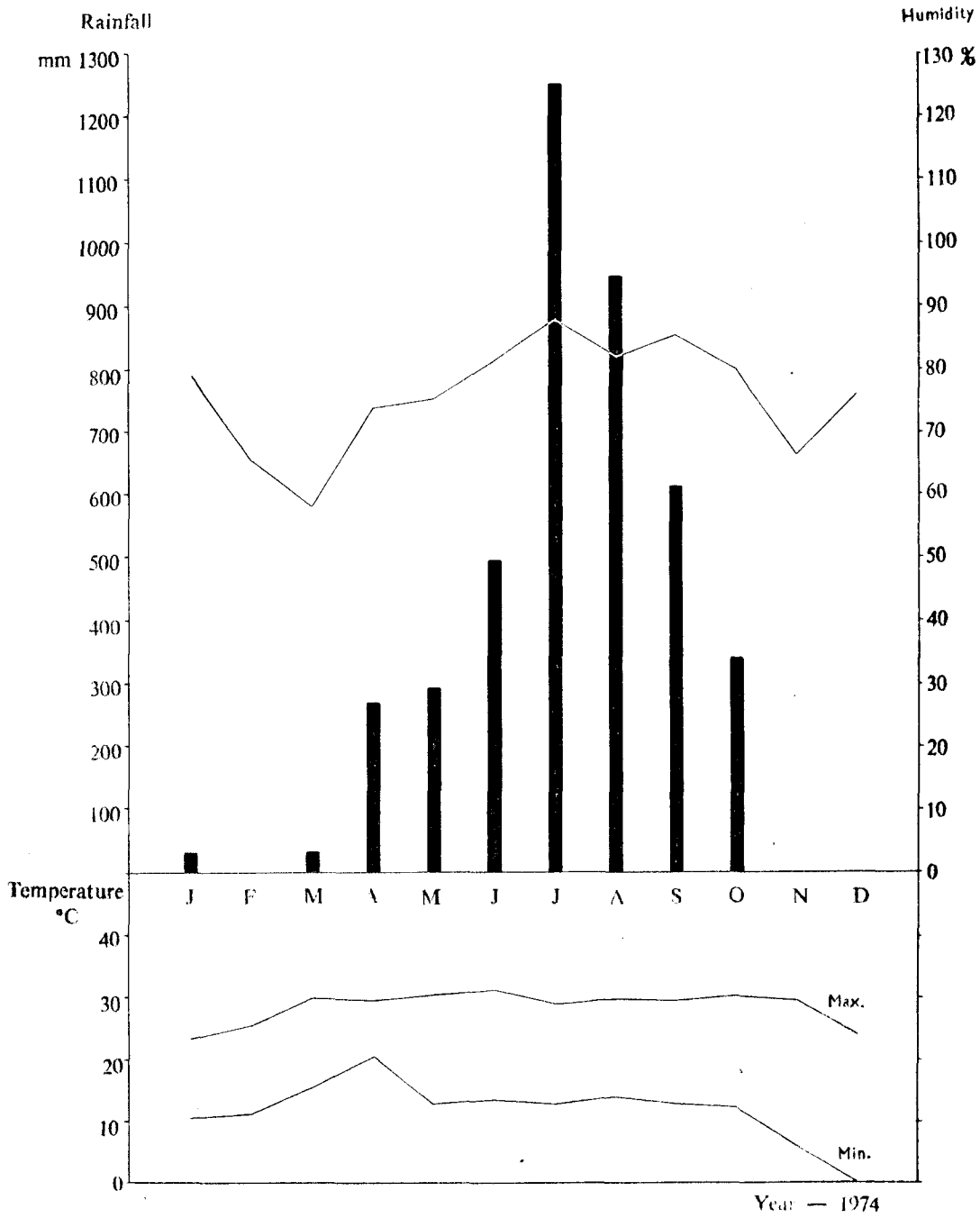


Fig. 1

MONTHLY MEAN METEOROLOGICAL DATA OF JALPAIGURI

SCIENCE DURING THE PERIOD JAN.- 1974 TO DEC.- 1974.

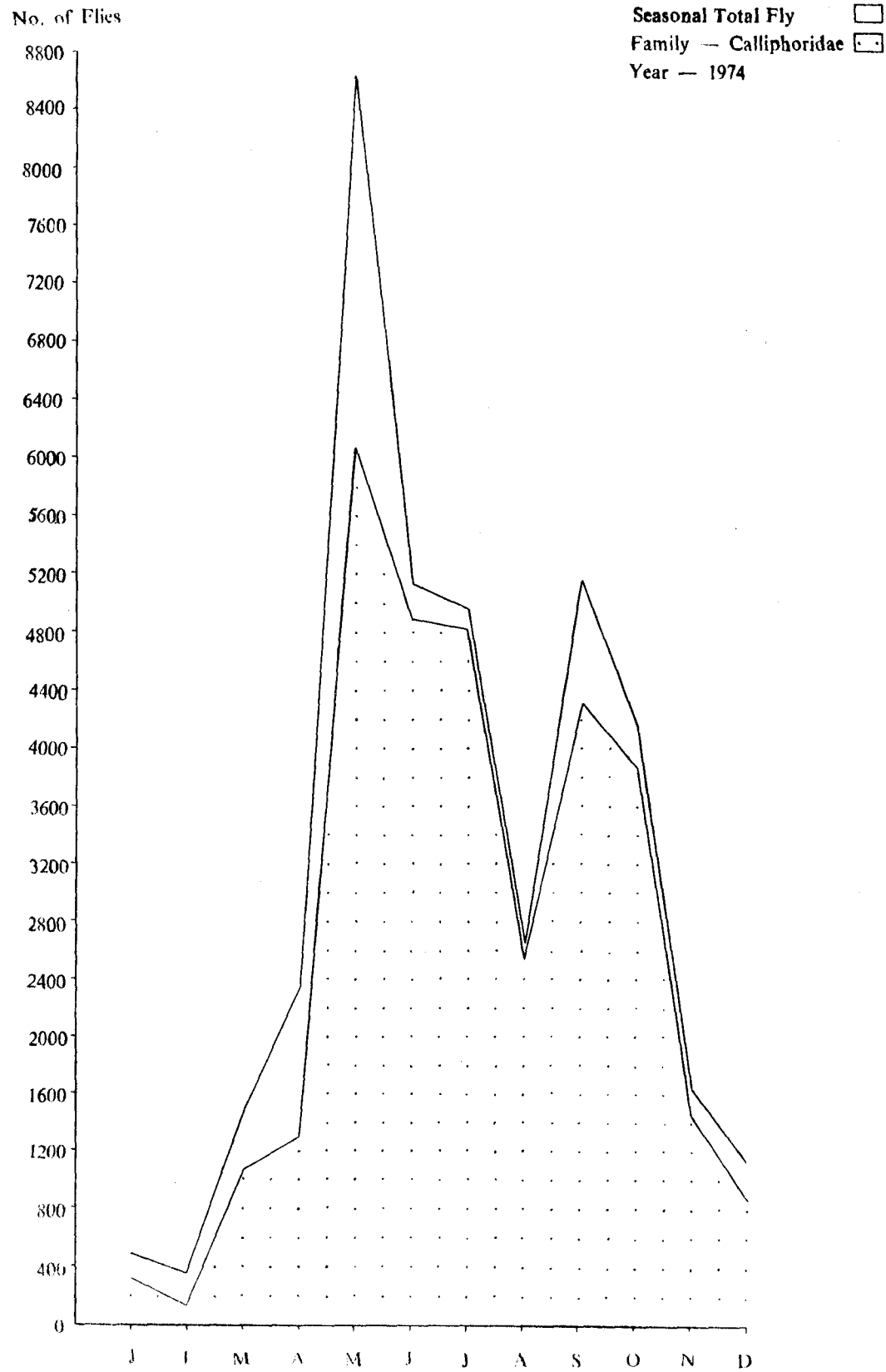

No. of Flies
Seasonal Total Fly
Family — Calliphoridae
Year — 1974
8800
8400
8000
7600
7200
6800
6400
6000
5600
5200
4800
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
J
F
M
A
M
J
J
A
S
O
N
D

Fig. 2

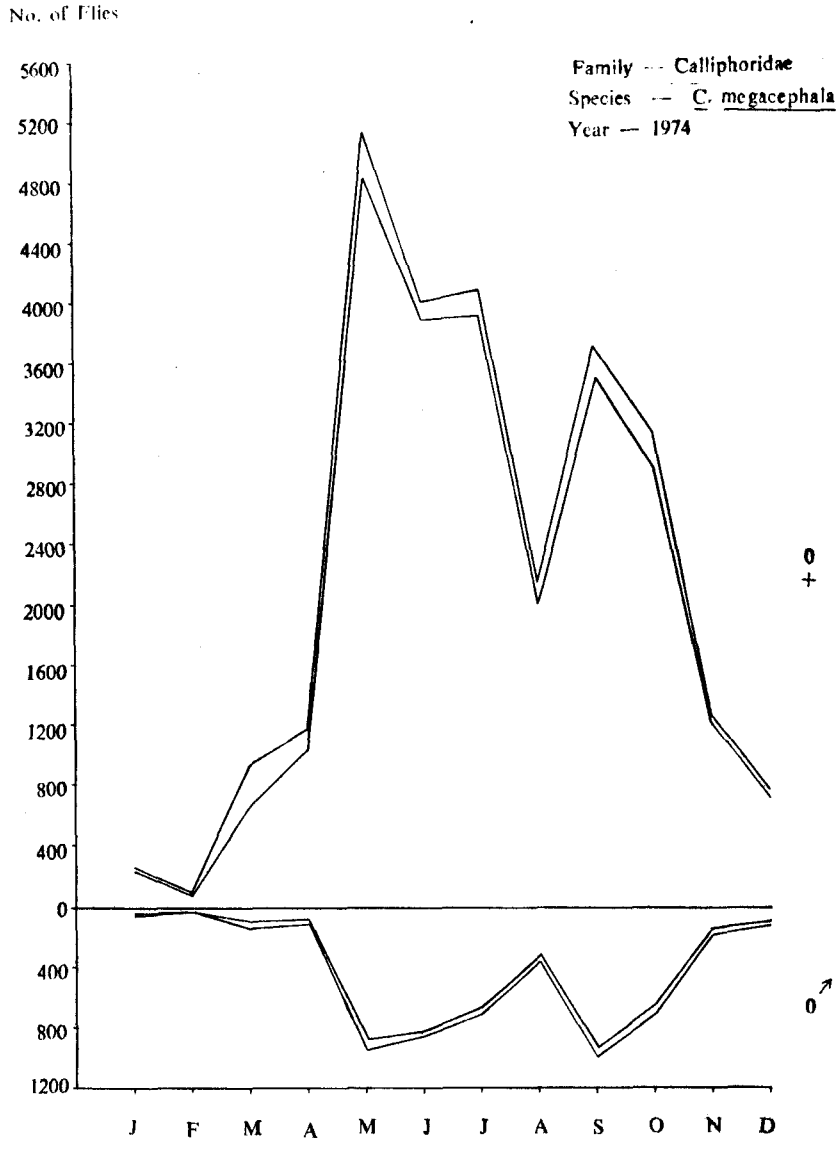

No. of Flies
Family — Calliphoridae
Species — C. megacephala
Year — 1974
5600
5200
4800
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
400
800
1200
♀ 0
♂ 0
J F M A M J J A S O N D

Fig. 3

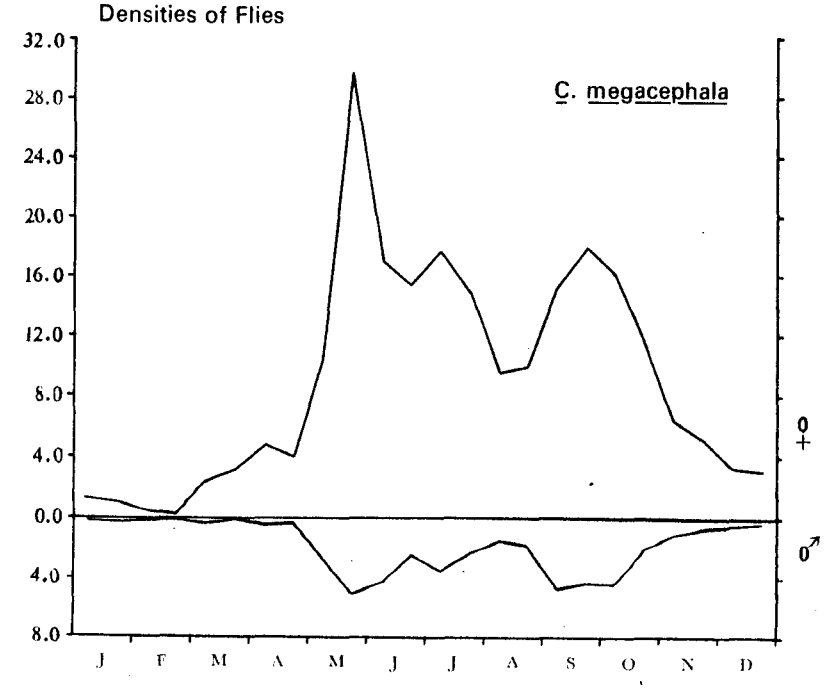

Densities of Flies
C. megacephala
32.0
28.0
24.0
20.0
16.0
12.0
8.0
4.0
0.0
4.0
8.0
♀ 0
♂ 0
J F M A M J J A S O N D

Fig. 4

Family — Calliphoridae
Species — C. rufifacies
Year — 1974

No. of Flies

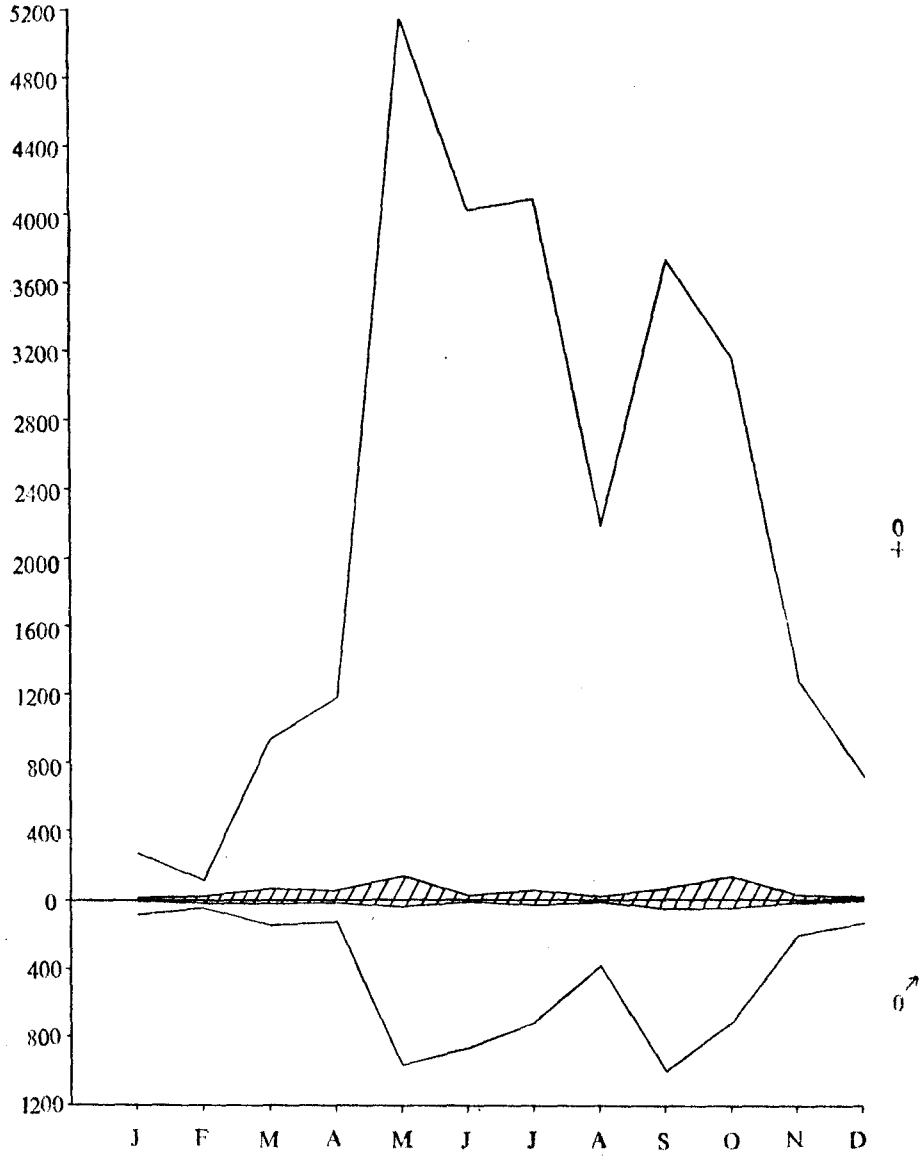


Fig. 5

Densities of Flies

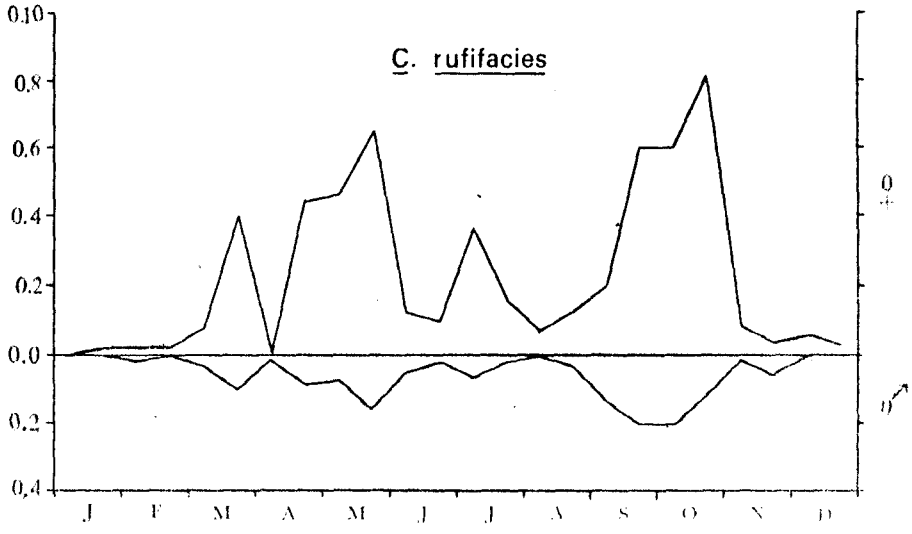


Fig. 6

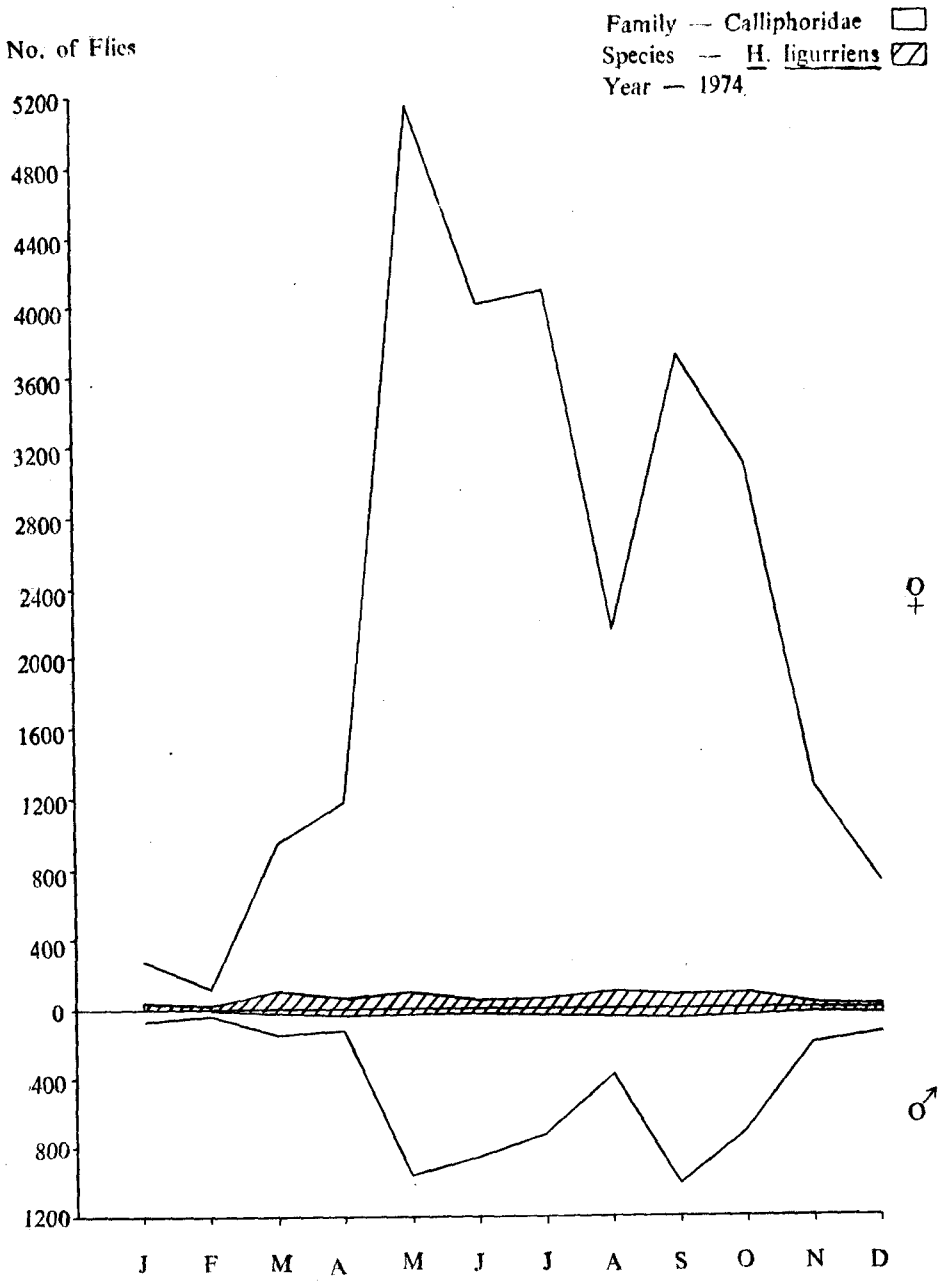

Family — Calliphoridae
Species — H. ligurriens
Year — 1974
No. of Flies
5200
4800
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
400
800
1200
♀
♂
J F M A M J J A S O N D

Fig. 7

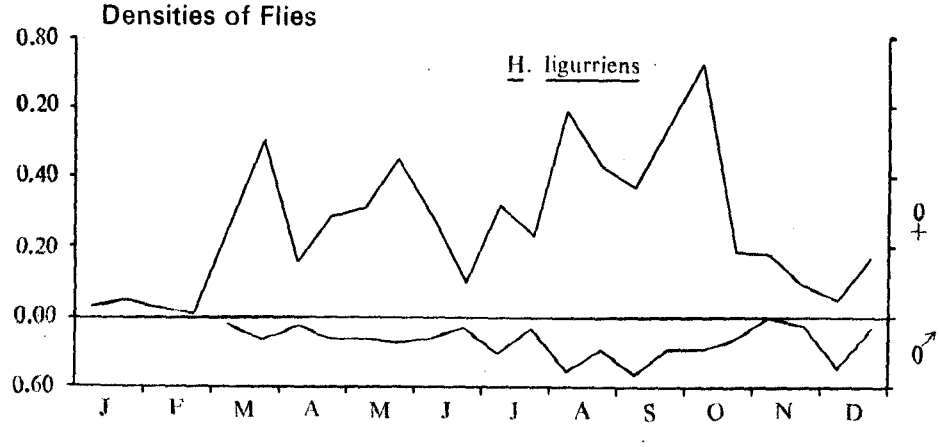

Densities of Flies
H. ligurriens
0.80
0.20
0.40
0.20
0.00
0.60
♀
♂
J F M A M J J A S O N D

Fig. 8

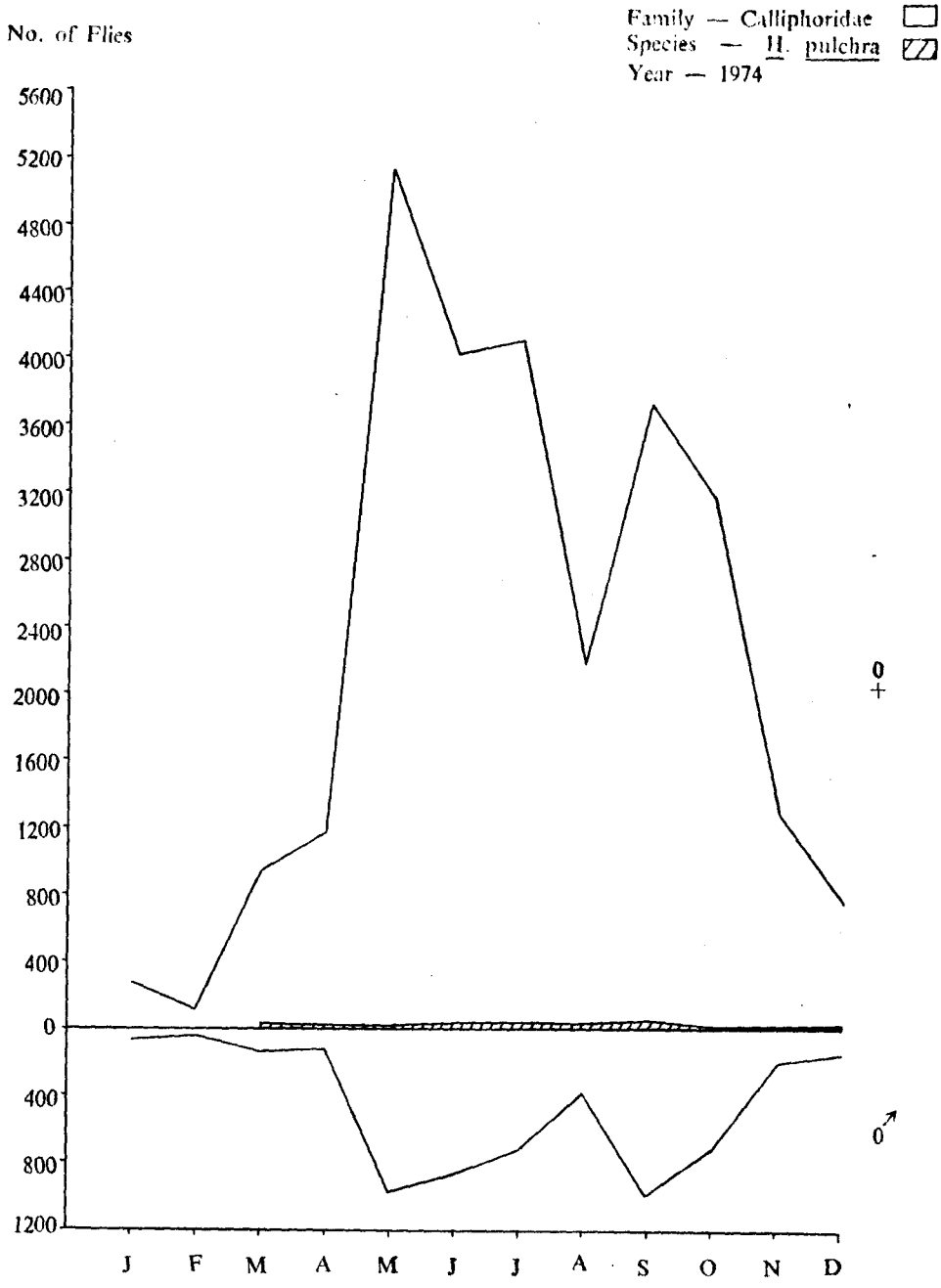

No. of Flies
Family — Calliphoridae
Species — H. pulchra
Year — 1974
5600
5200
4800
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
400
800
1200
0
0
J F M A M J J A S O N D

Fig. 9

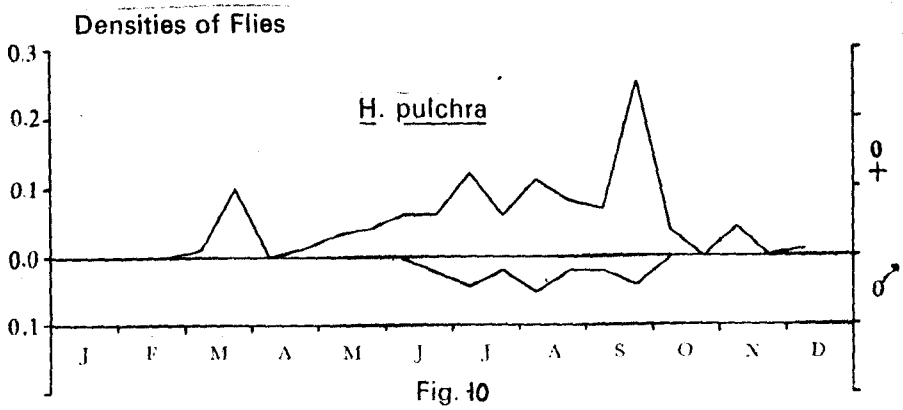

Densities of Flies
H. pulchra
0.3
0.2
0.1
0.0
0.1
0
0
J F M A M J J A S O N D

Fig. 10

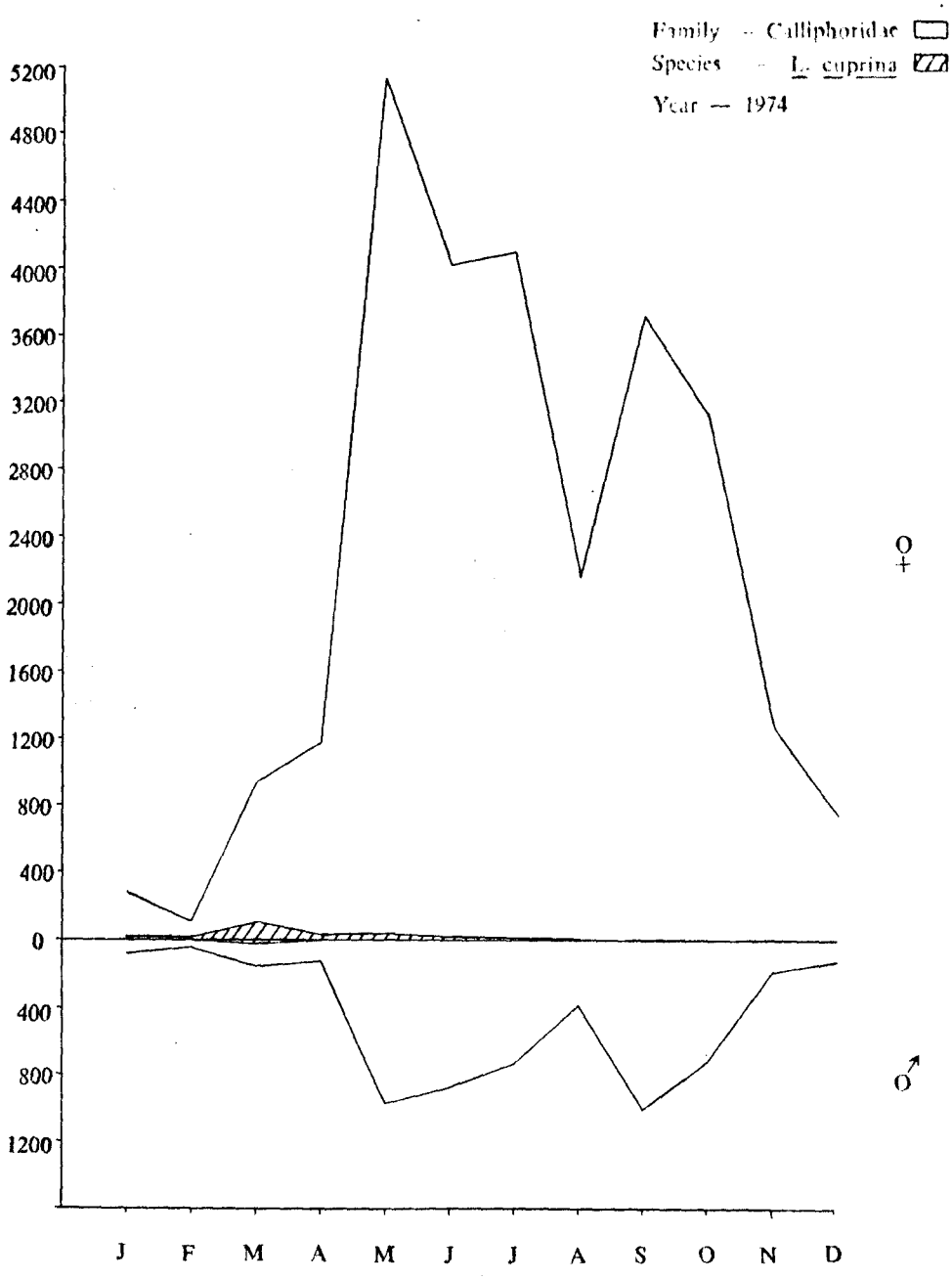

Family – Calliphoridae
Species – L. cuprina
Year — 1974
5200
4800
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
400
800
1200
♀
♂
J F M A M J J A S O N D

Fig. 11

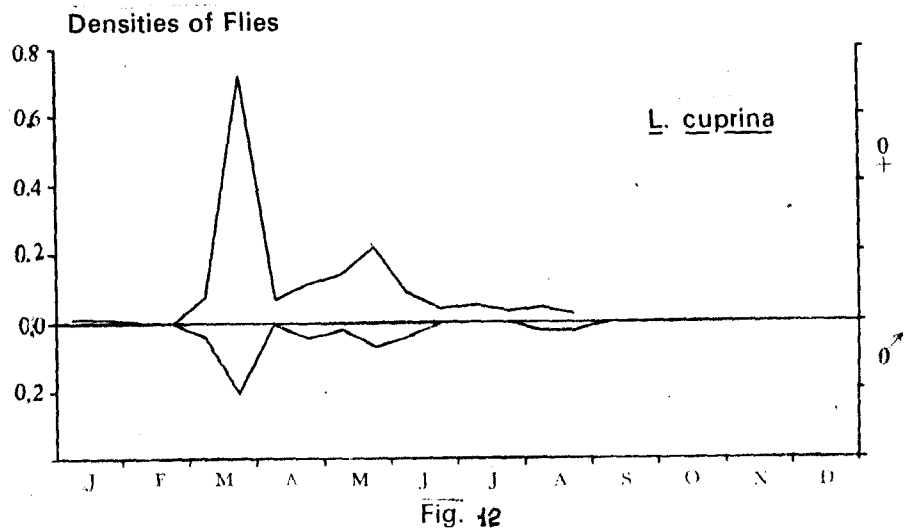

Densities of Flies
0.8
0.6
0.4
0.2
0,0
0,2
L. cuprina
♀
♂
J F M A M J J A S O N D

Fig. 12

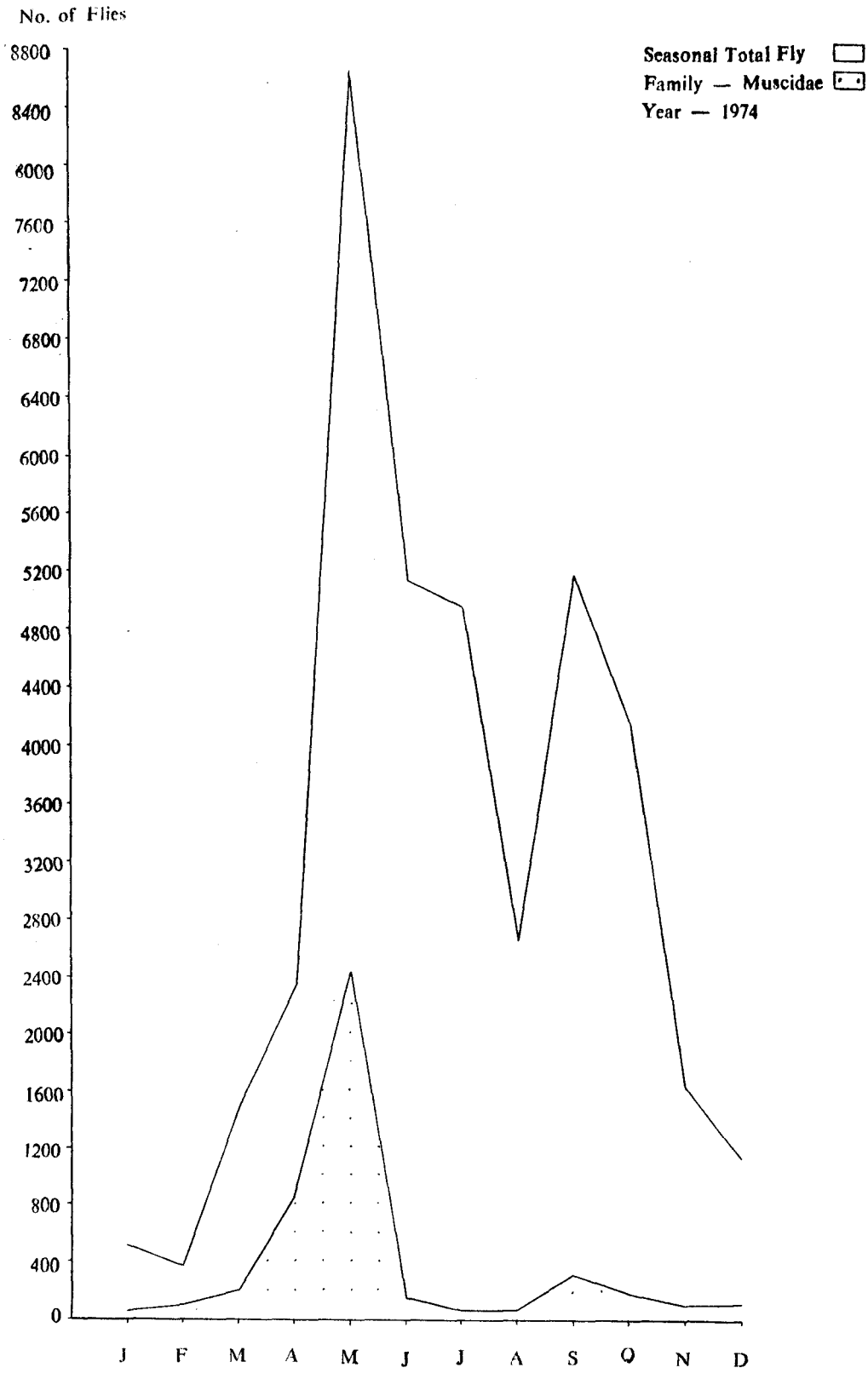

No. of Flies
Seasonal Total Fly
Family — Muscidae
Year — 1974
8800
8400
8000
7600
7200
6800
6400
6000
5600
5200
4800
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
J
F
M
A
M
J
J
A
S
O
N
D

Fig. 13

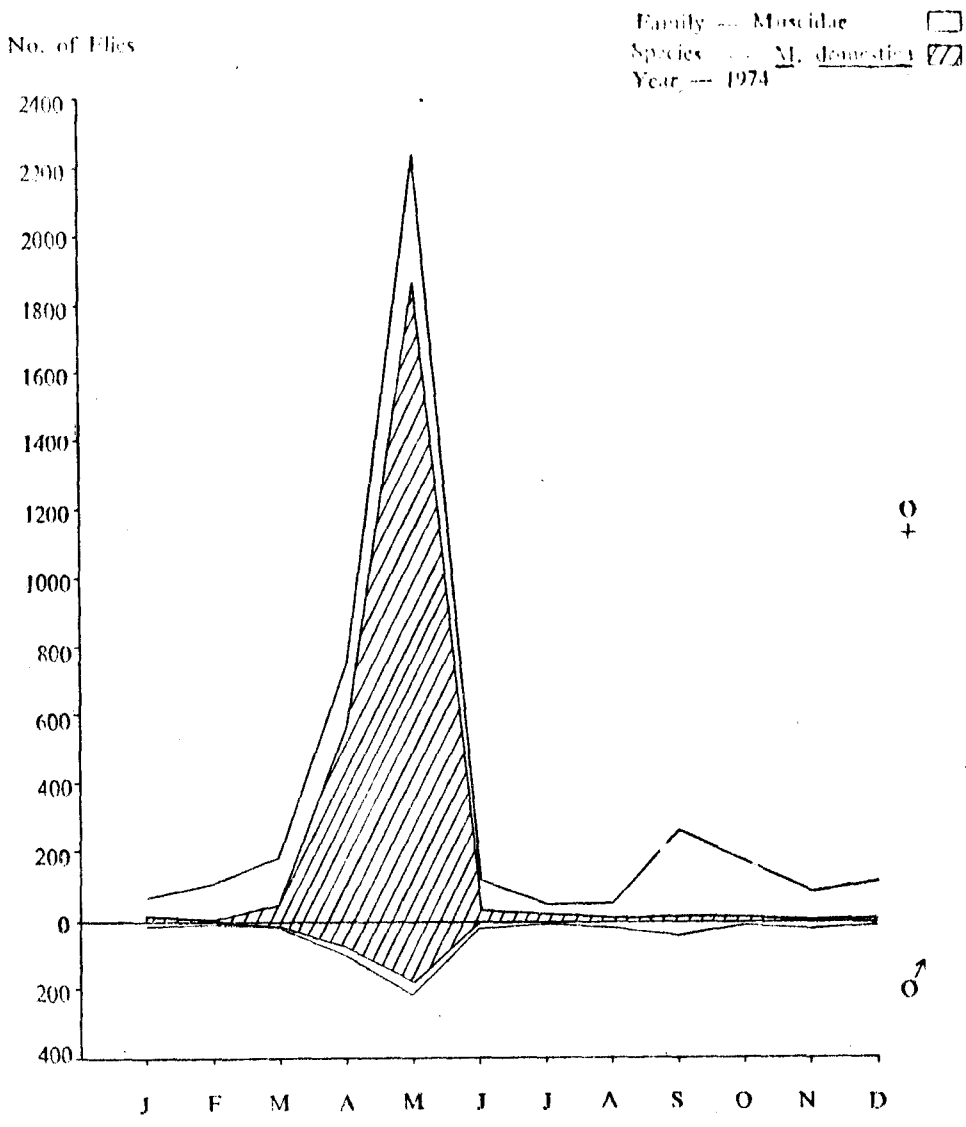

No. of Flies
Family — Muscidae
Species — M. domestica
Year — 1974
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
200
400
♀
♂
J F M A M J J A S O N D

Fig. 14

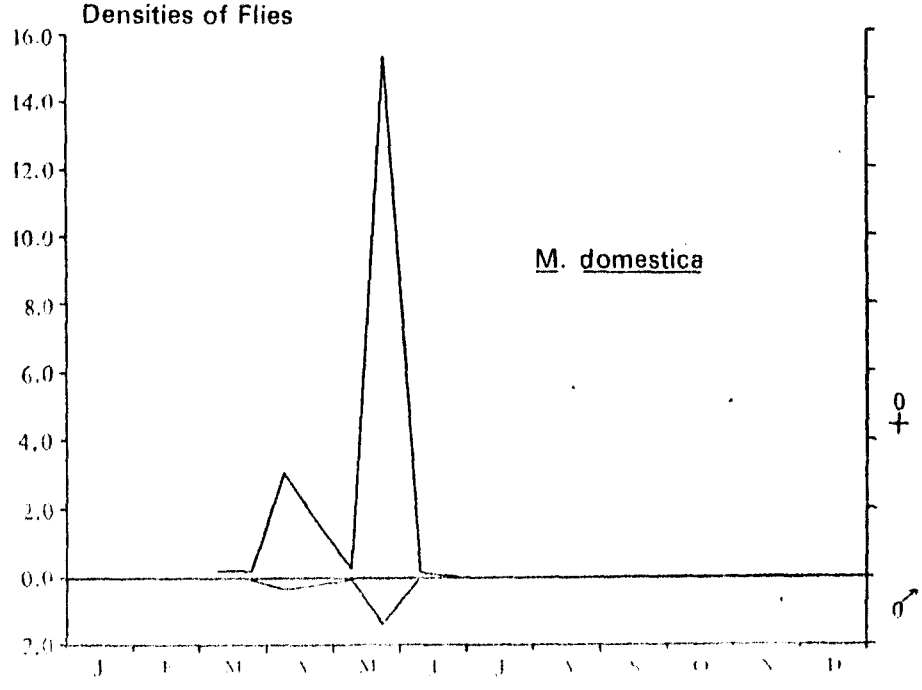

Densities of Flies
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
2.0
M. domestica
♀
♂

Fig. 15

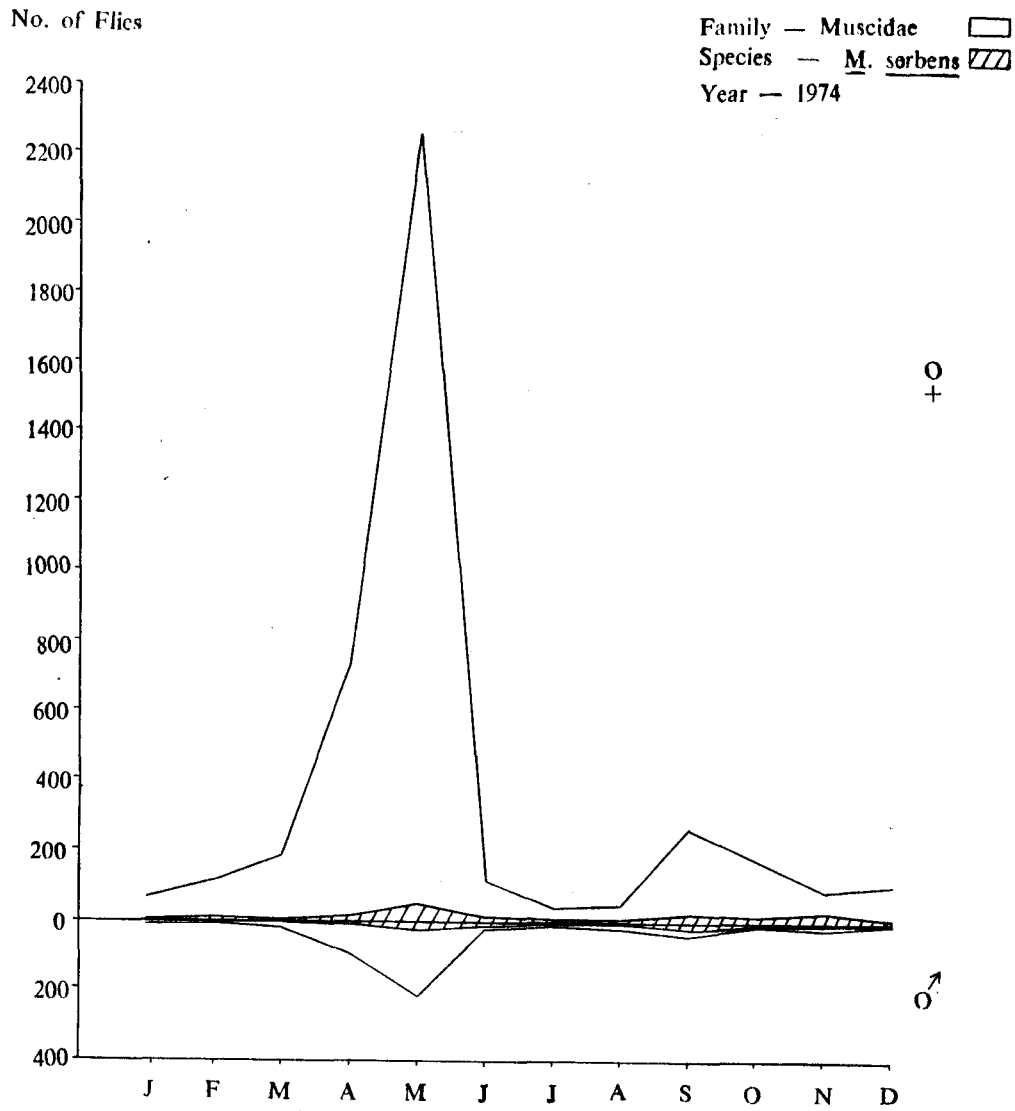

No. of Flies
Family — Muscidae
Species — M. sorbens
Year — 1974
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
200
400
♀
♂
J F M A M J J A S O N D

Fig. 16

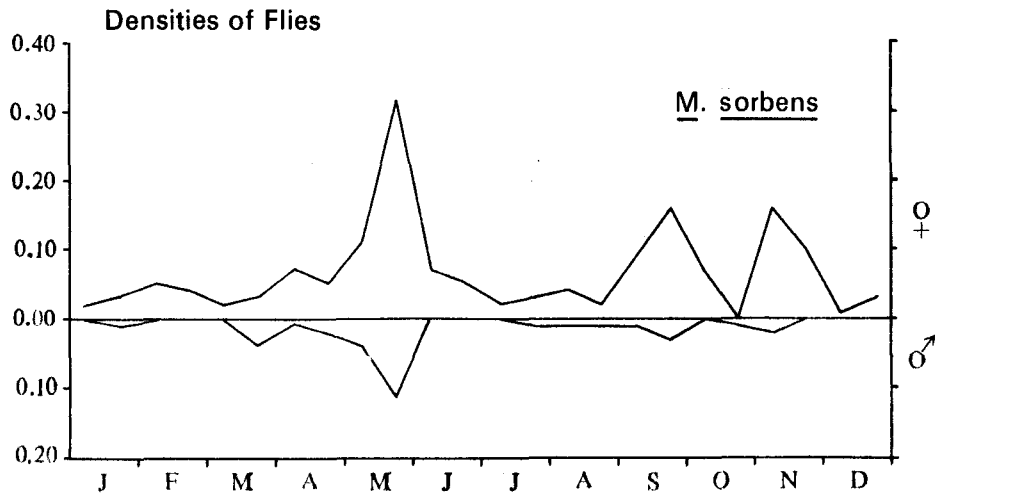

Densities of Flies
M. sorbens
0.40
0.30
0.20
0.10
0.00
0.10
0.20
♀
♂
J F M A M J J A S O N D

Fig. 17

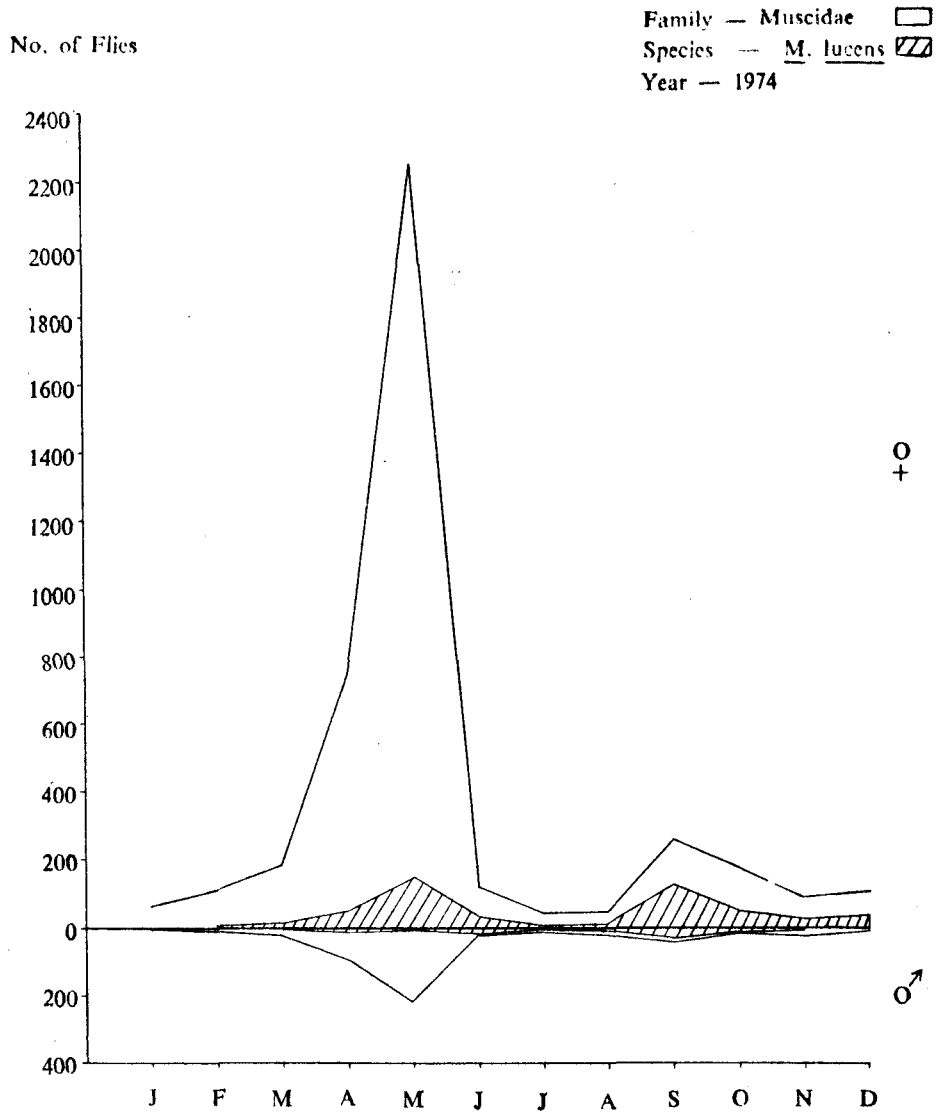

No. of Flies
Family — Muscidae
Species — M. lucens
Year — 1974
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
200
400
♀
♂
J F M A M J J A S O N D

Fig. 18

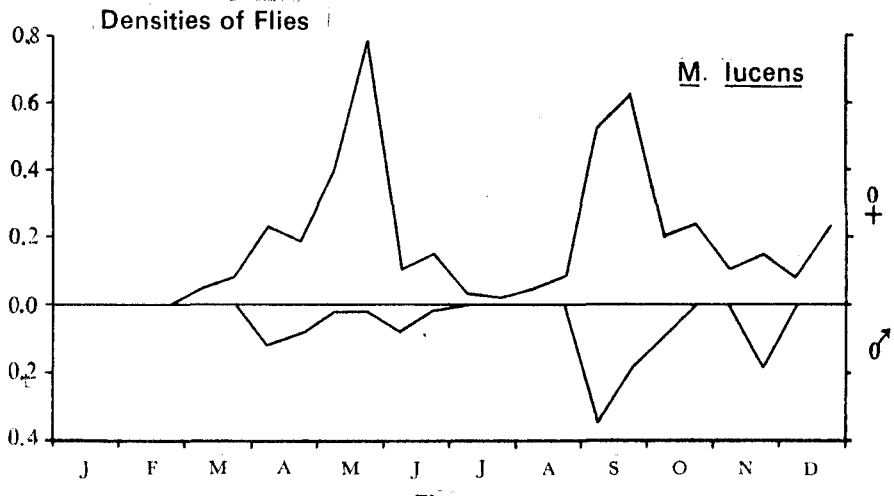

Densities of Flies
M. lucens
0.8
0.6
0.4
0.2
0.0
0.2
0.4
♀
♂
J F M A M J J A S O N D

Fig. 19

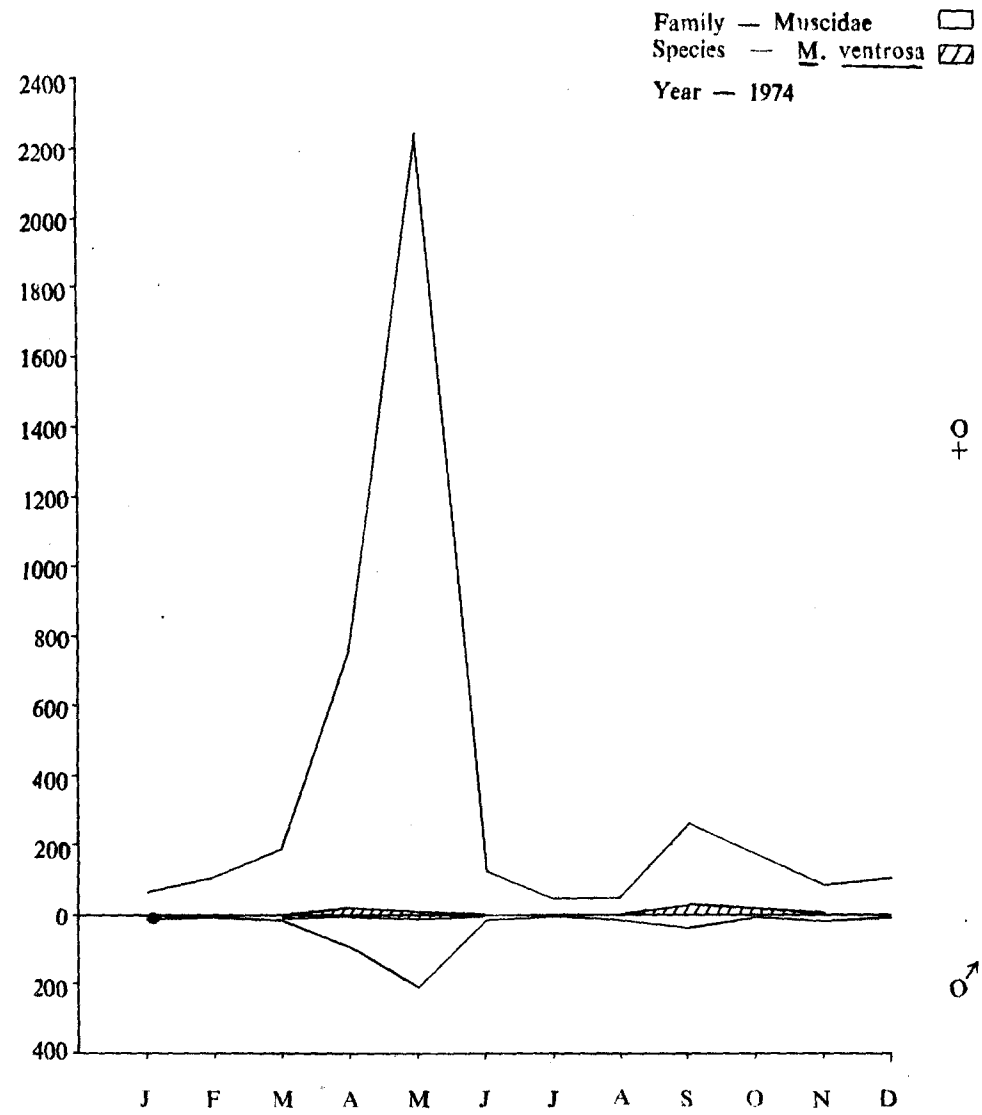

Family — Muscidae
Species — M. ventrosa
Year — 1974
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
200
400
J F M A M J J A S O N D
♀
♂

Fig. 20

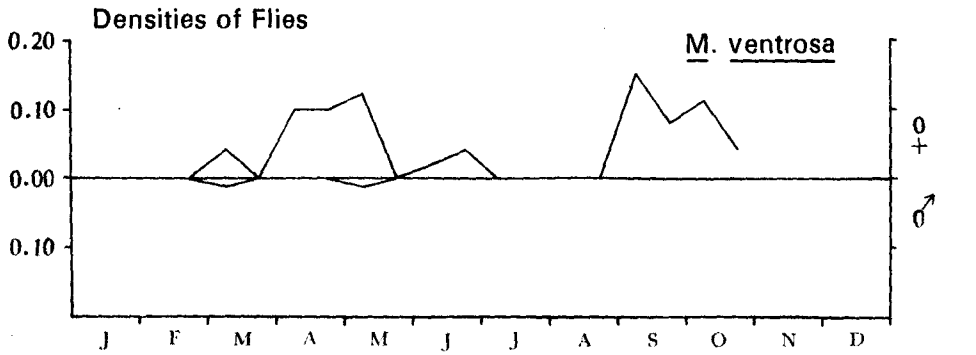

Densities of Flies
M. ventrosa
0.20
0.10
0.00
0.10
J F M A M J J A S O N D
♀
♂

Fig. 21

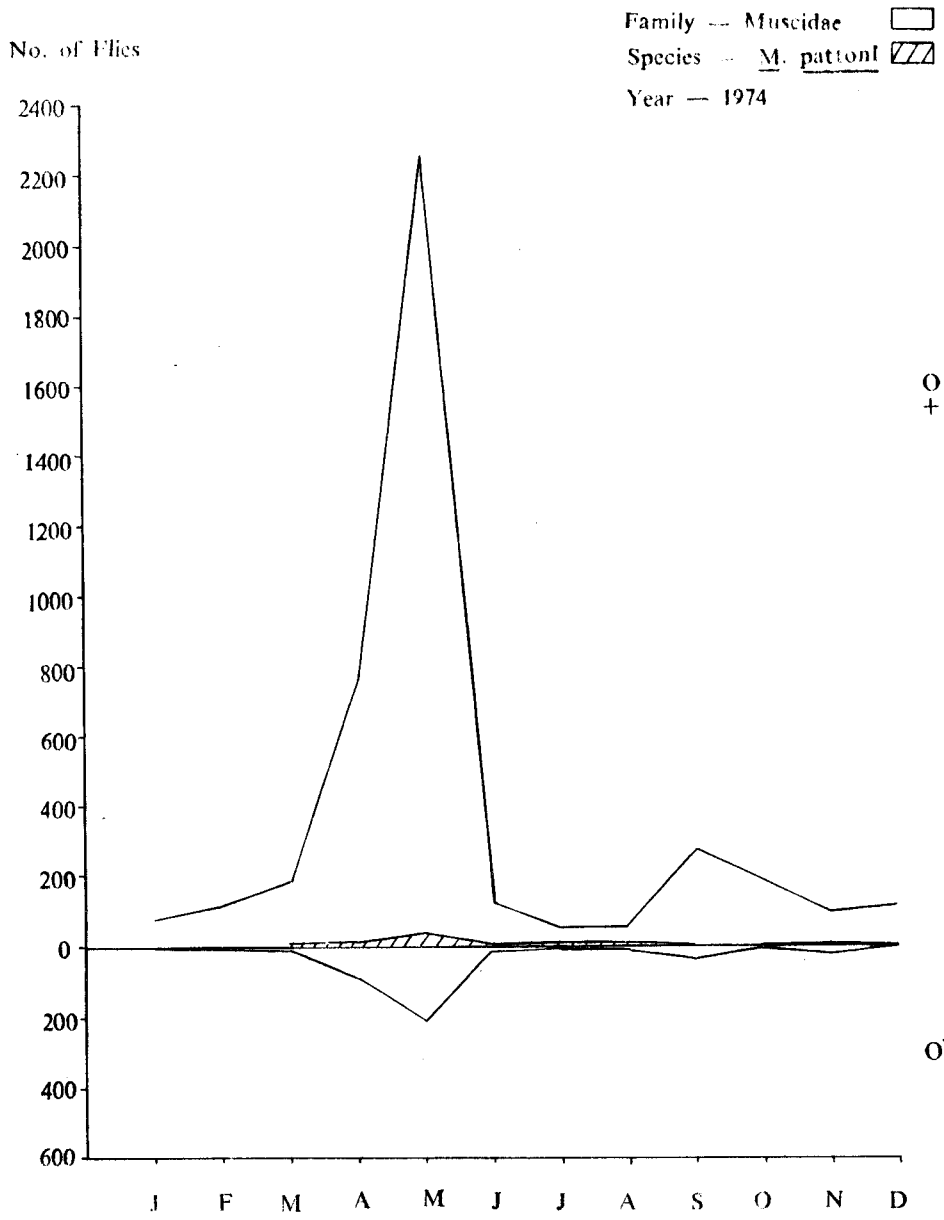

Family — Muscidae
Species — M. pattoni
Year — 1974
No. of Flies
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
200
400
600
O
+
O♂
J F M A M J J A S O N D

Fig. 22

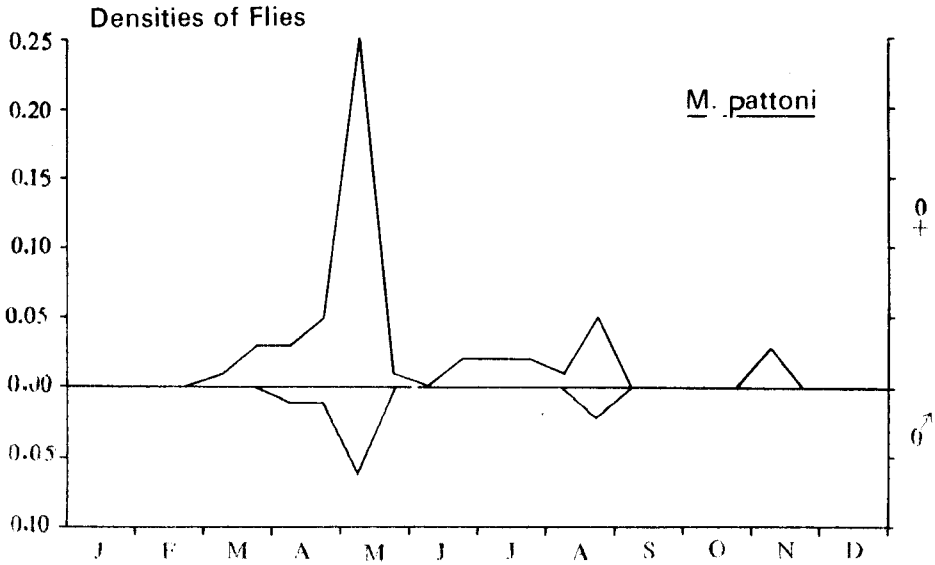

Densities of Flies
M. pattoni
0.25
0.20
0.15
0.10
0.05
0.00
0.05
0.10
0
+
0♂
J F M A M J J A S O N D

Fig. 23

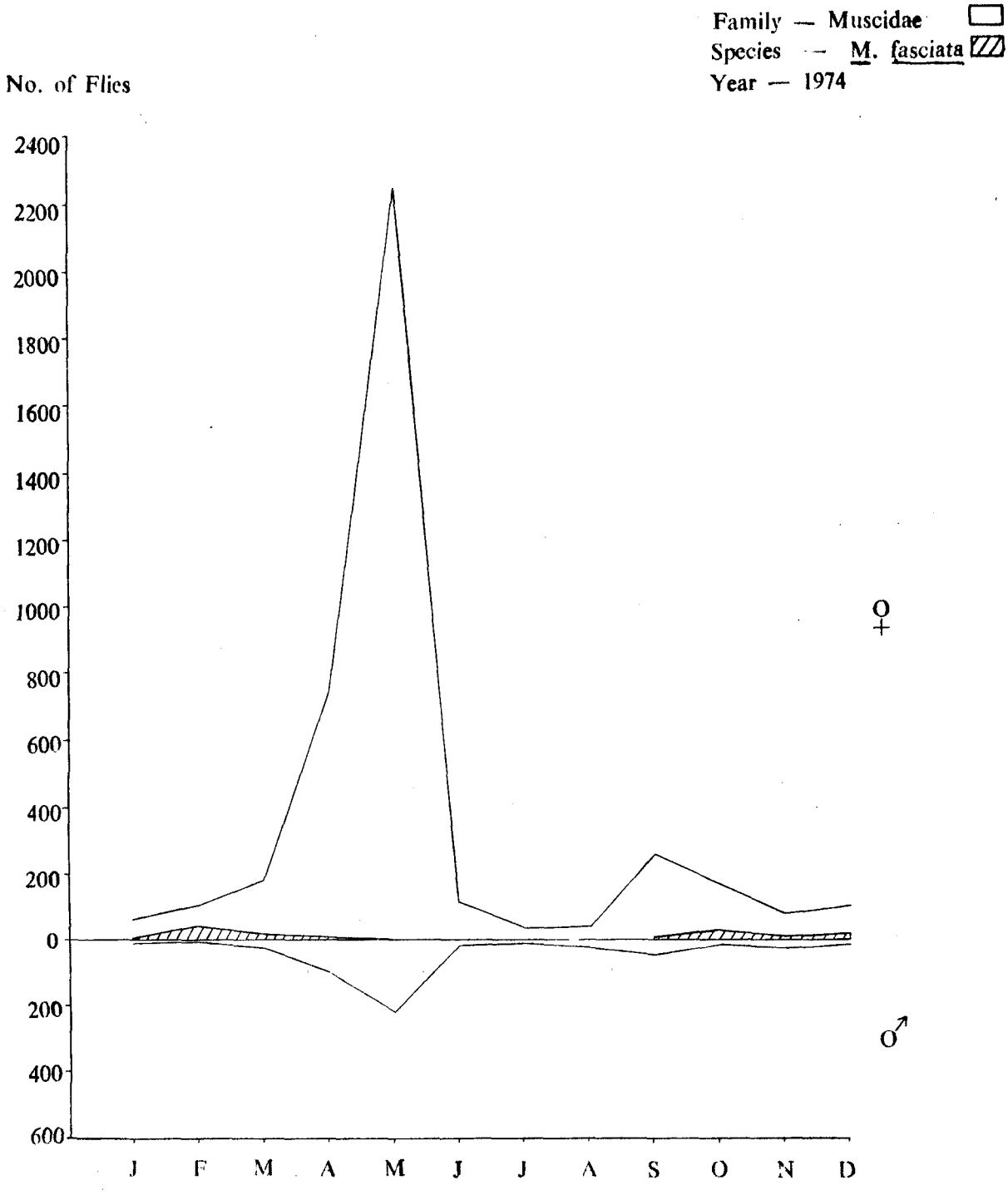

Family — Muscidae
Species — M. fasciata
Year — 1974
No. of Flies
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
200
400
600
♀
♂
J
F
M
A
M
J
J
A
S
O
N
D

Fig. 24

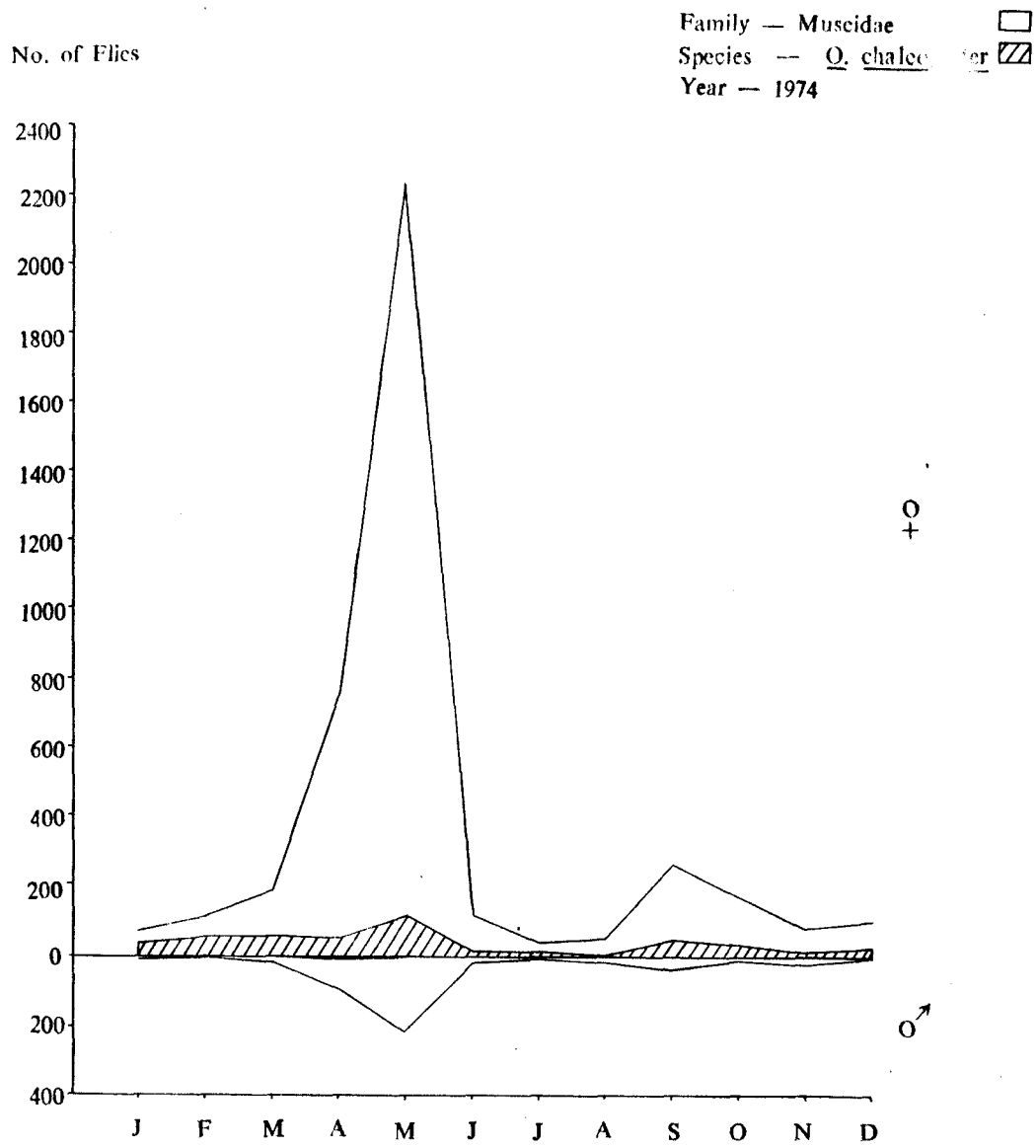

No. of Flies
Family — Muscidae
Species — O. chalco er
Year — 1974
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
200
400
J F M A M J J A S O N D
♀
♂

Fig. 25

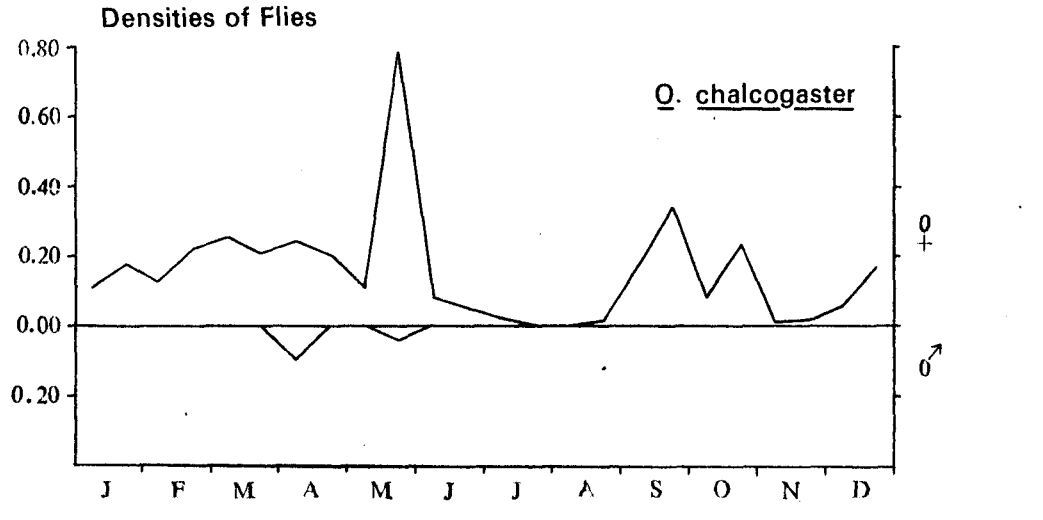

Densities of Flies
O. chalcogaster
0.80
0.60
0.40
0.20
0.00
0.20
J F M A M J J A S O N D
♀
♂

Fig. 26

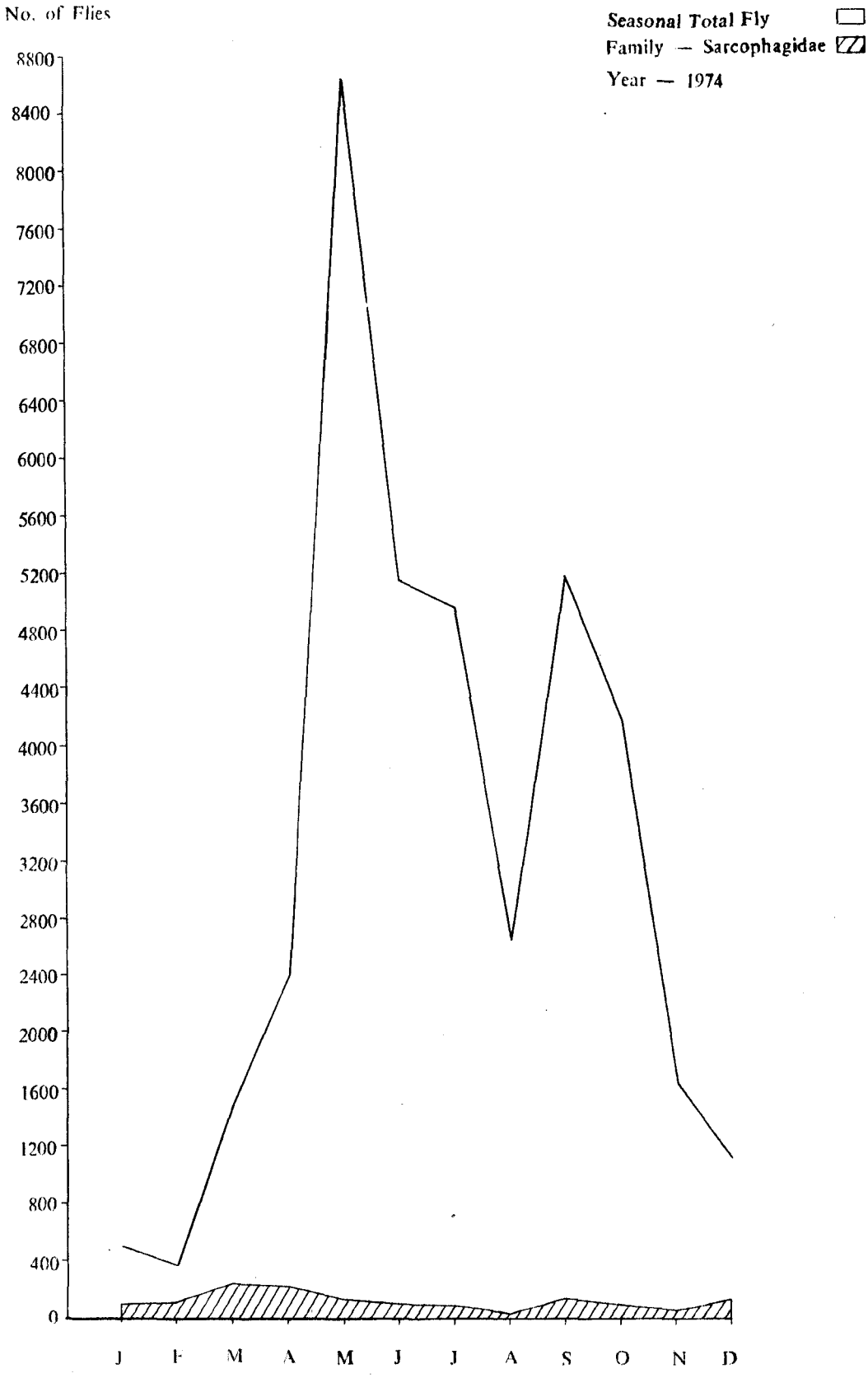

No. of Flies
Seasonal Total Fly
Family — Sarcophagidae
Year — 1974
8800
8400
8000
7600
7200
6800
6400
6000
5600
5200
4800
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
J
F
M
A
M
J
J
A
S
O
N
D

Fig. 27

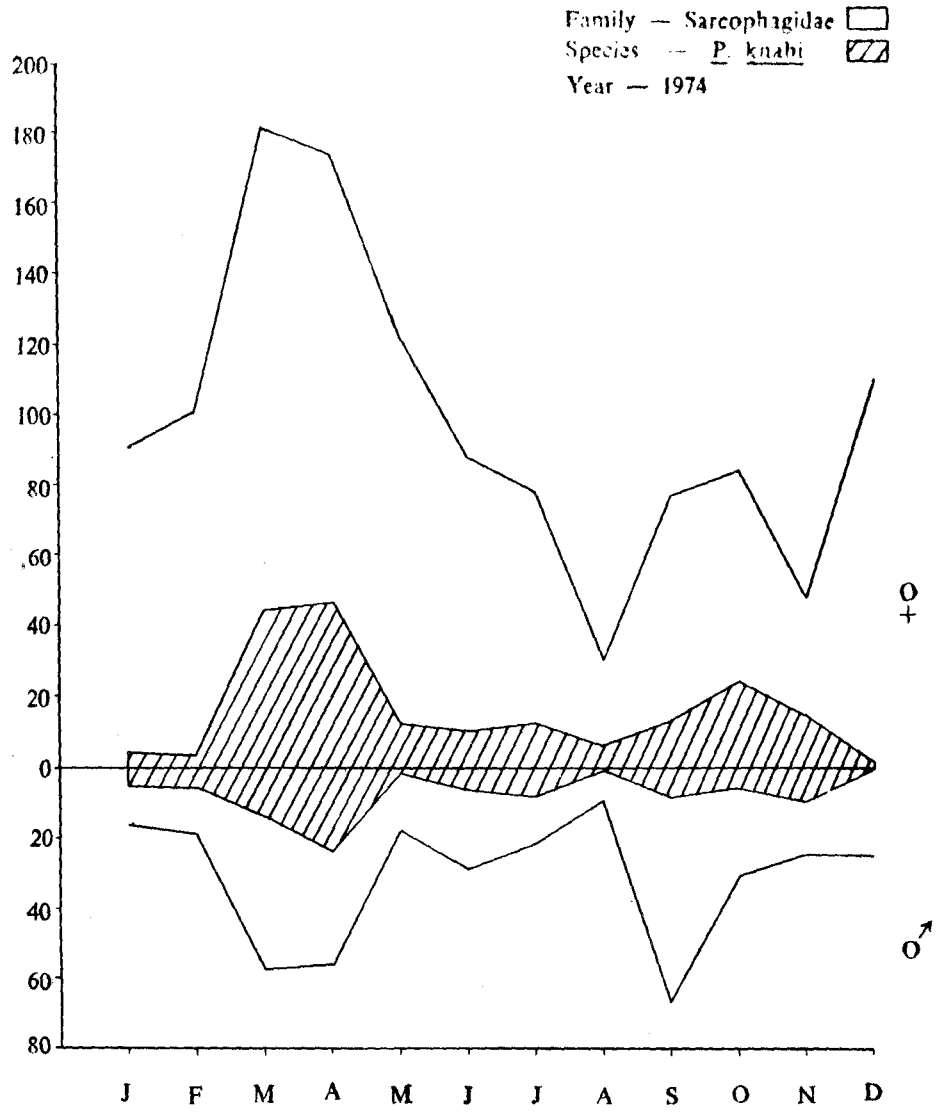

Family — Sarcophagidae
Species — P. knabi
Year — 1974
200
180
160
140
120
100
80
60
40
20
0
20
40
60
80
♀
♂
J F M A M J J A S O N D

Fig. 28

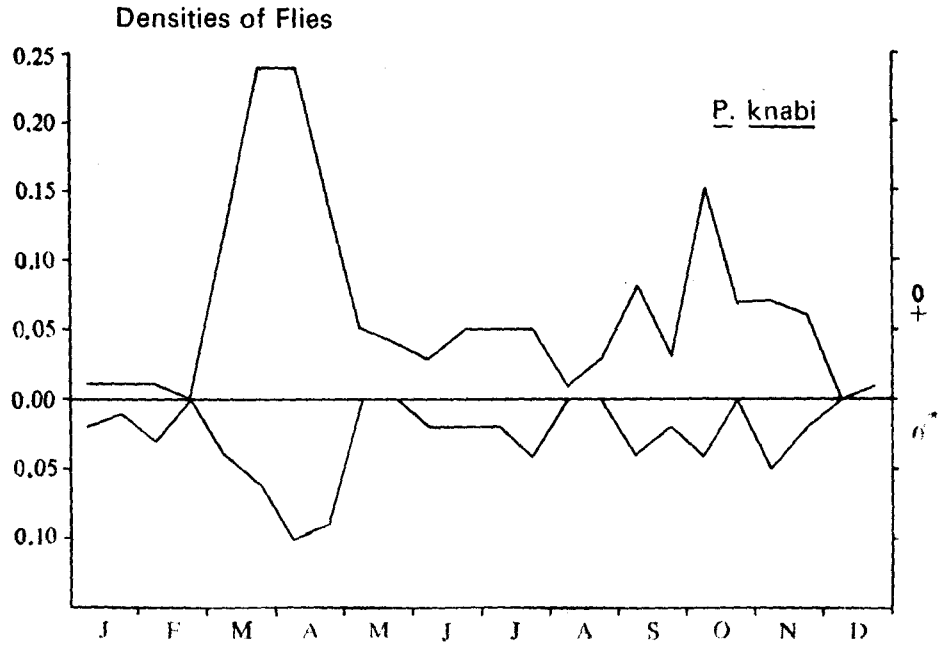

Densities of Flies
P. knabi
0.25
0.20
0.15
0.10
0.05
0.00
0.05
0.10
♀
♂
J F M A M J J A S O N D

Fig. 29

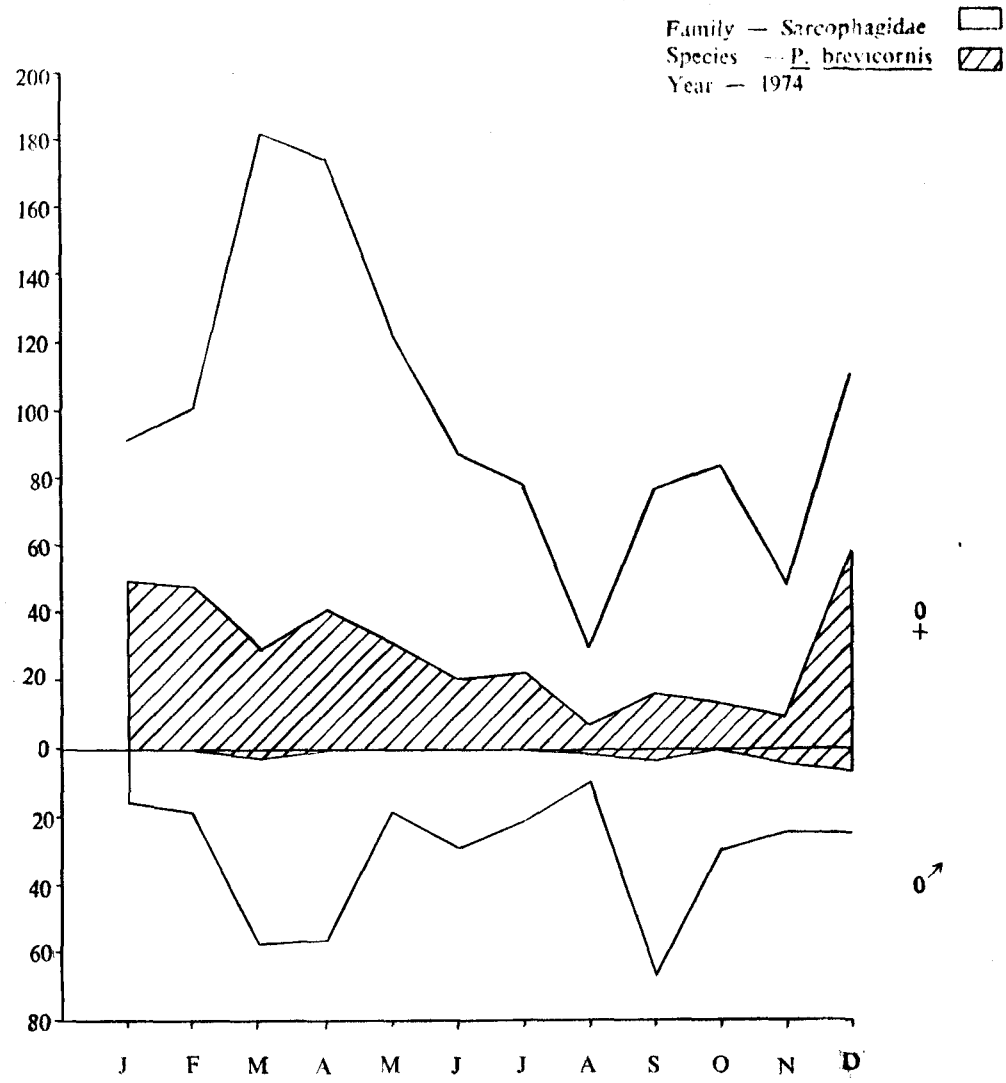

Family — Sarcophagidae
Species — P. brevicornis
Year — 1974
200
180
160
140
120
100
80
60
40
20
0
20
40
60
80
J F M A M J J A S O N D
♀
♂

Fig. 30

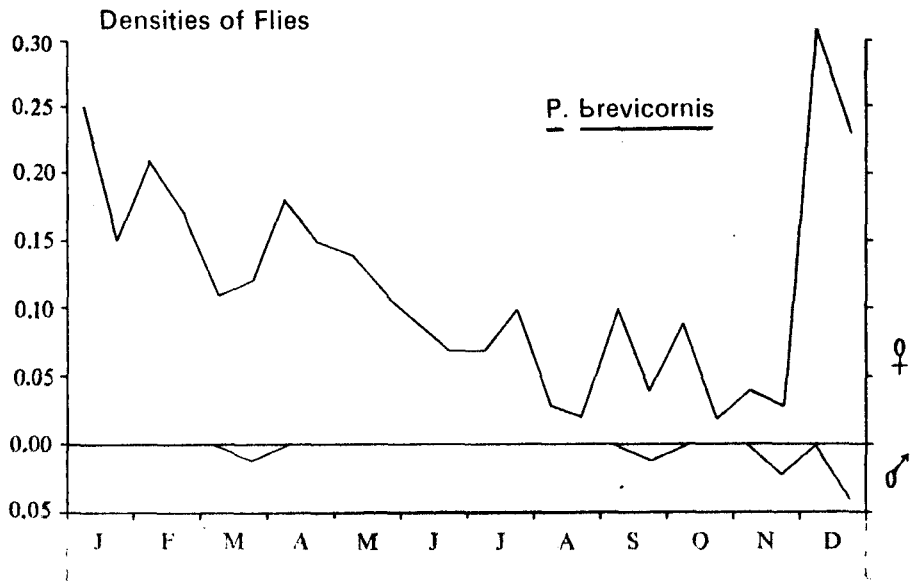

Densities of Flies
P. brevicornis
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.05
J F M A M J J A S O N D
♀
♂

Fig. 31

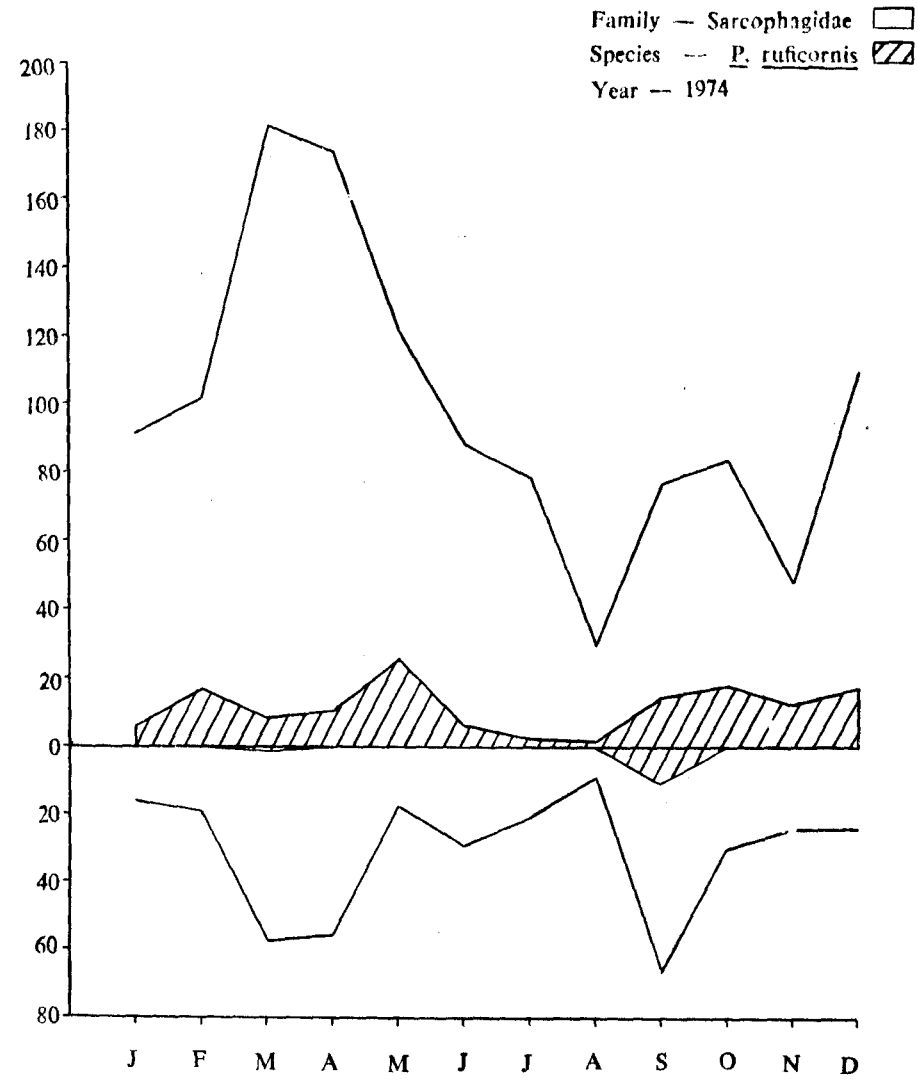

Family — Sarcophagidae
Species — P. ruficornis
Year — 1974
200
180
160
140
120
100
80
60
40
20
0
20
40
60
80
J F M A M J J A S O N D

Fig. 32

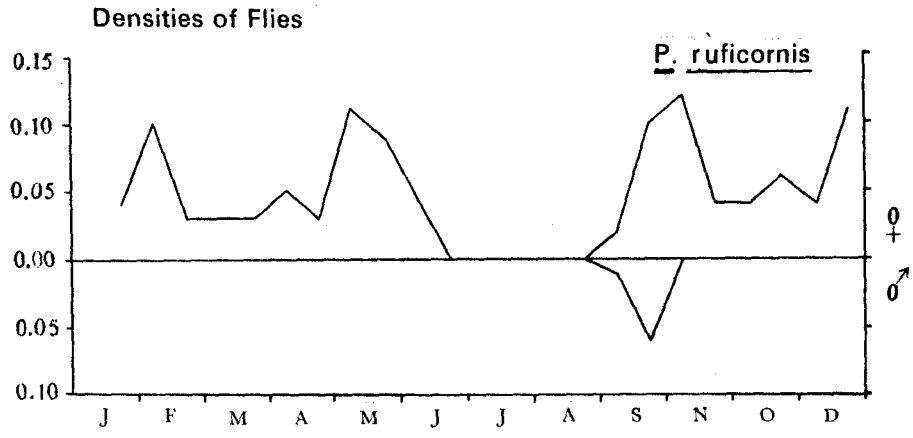

Densities of Flies
P. ruficornis
0.15
0.10
0.05
0.00
0.05
0.10
♀
♂
J F M A M J J A S N O D

Fig. 33

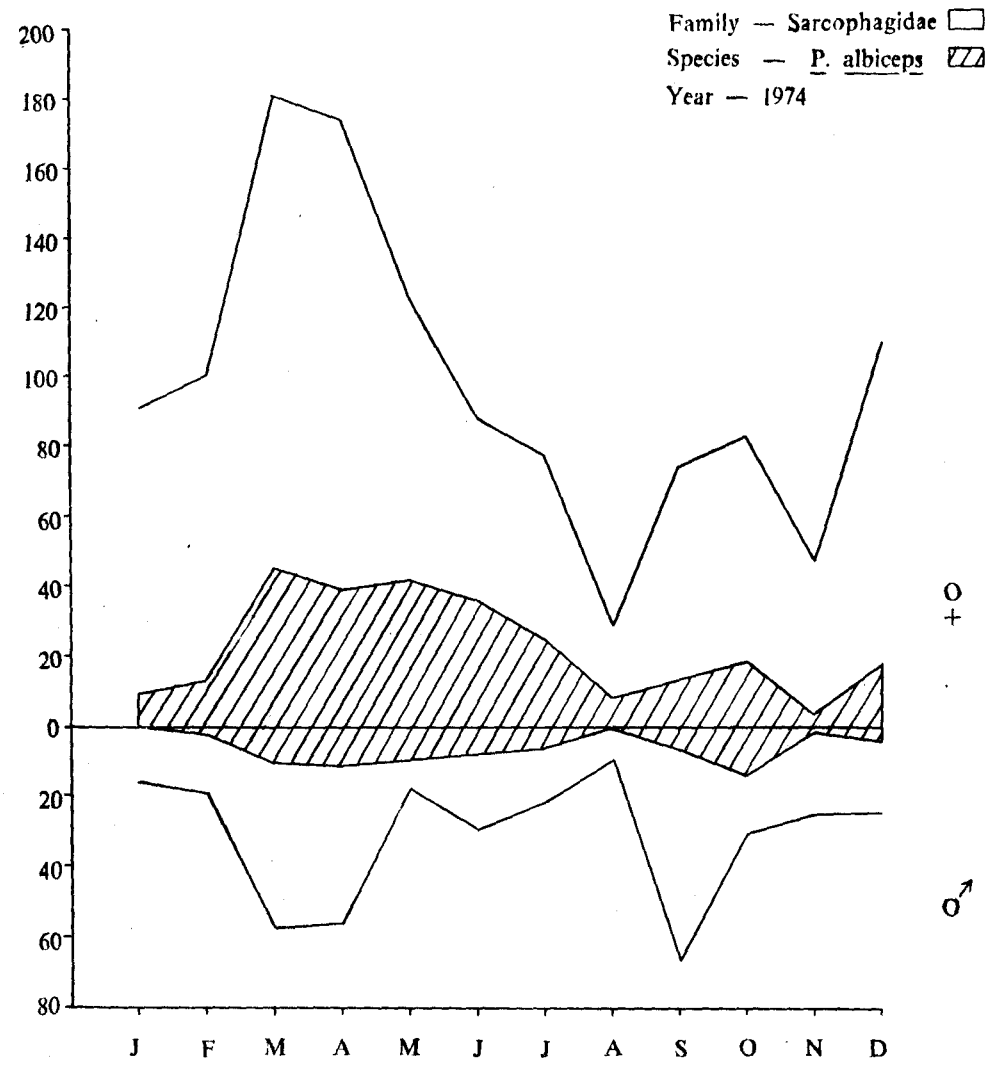

Family — Sarcophagidae
Species — P. albiceps
Year — 1974
200
180
160
140
120
100
80
60
40
20
0
20
40
60
80
J F M A M J J A S O N D
♀
+
♂

Fig. 34

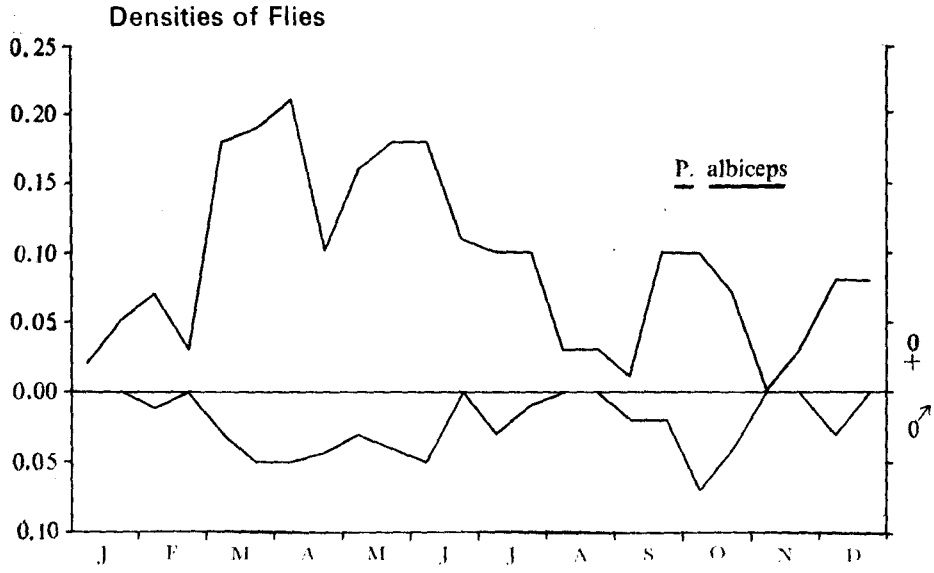

Densities of Flies
0.25
0.20
0.15
0.10
0.05
0.00
0.05
0.10
P. albiceps
J F M A M J J A S O N D
♀
+
♂

Fig. 35

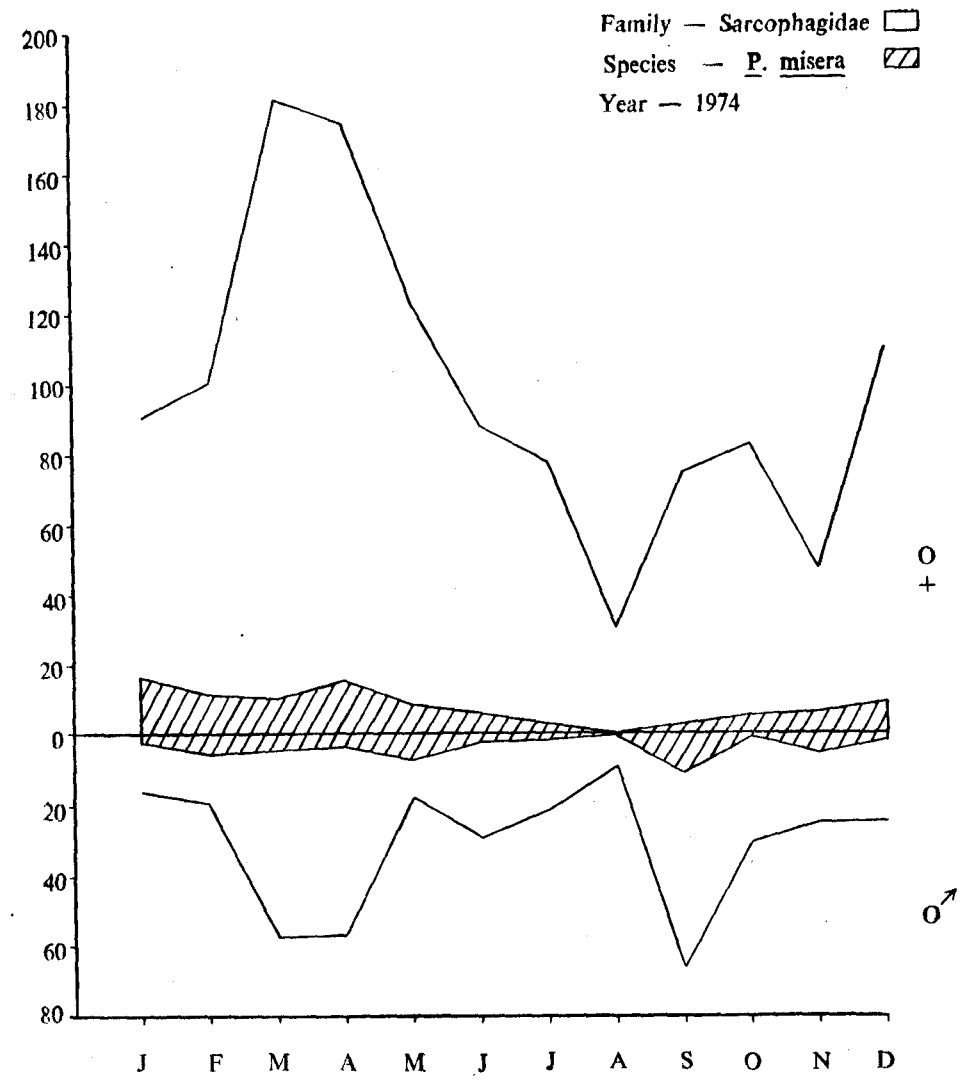

Family — Sarcophagidae
Species — P. misera
Year — 1974
200
180
160
140
120
100
80
60
40
20
0
20
40
60
80
O
+
O♂
J F M A M J J A S O N D

Fig. 36

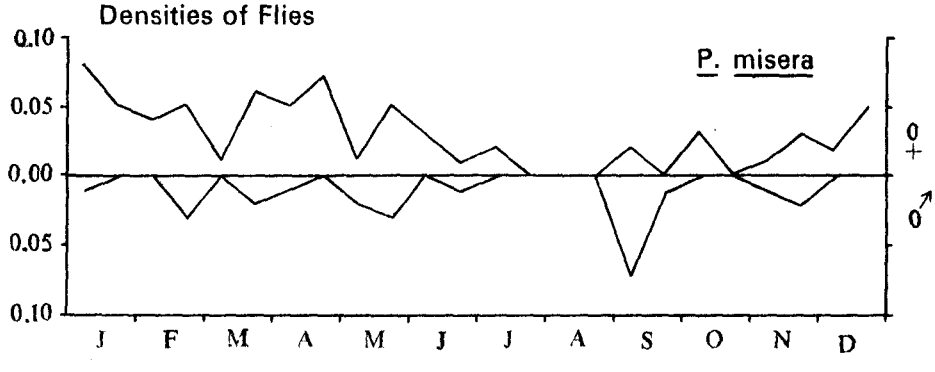

Densities of Flies
P. misera
0.10
0.05
0.00
0.05
0.10
0
+
0♂
J F M A M J J A S O N D

Fig. 37

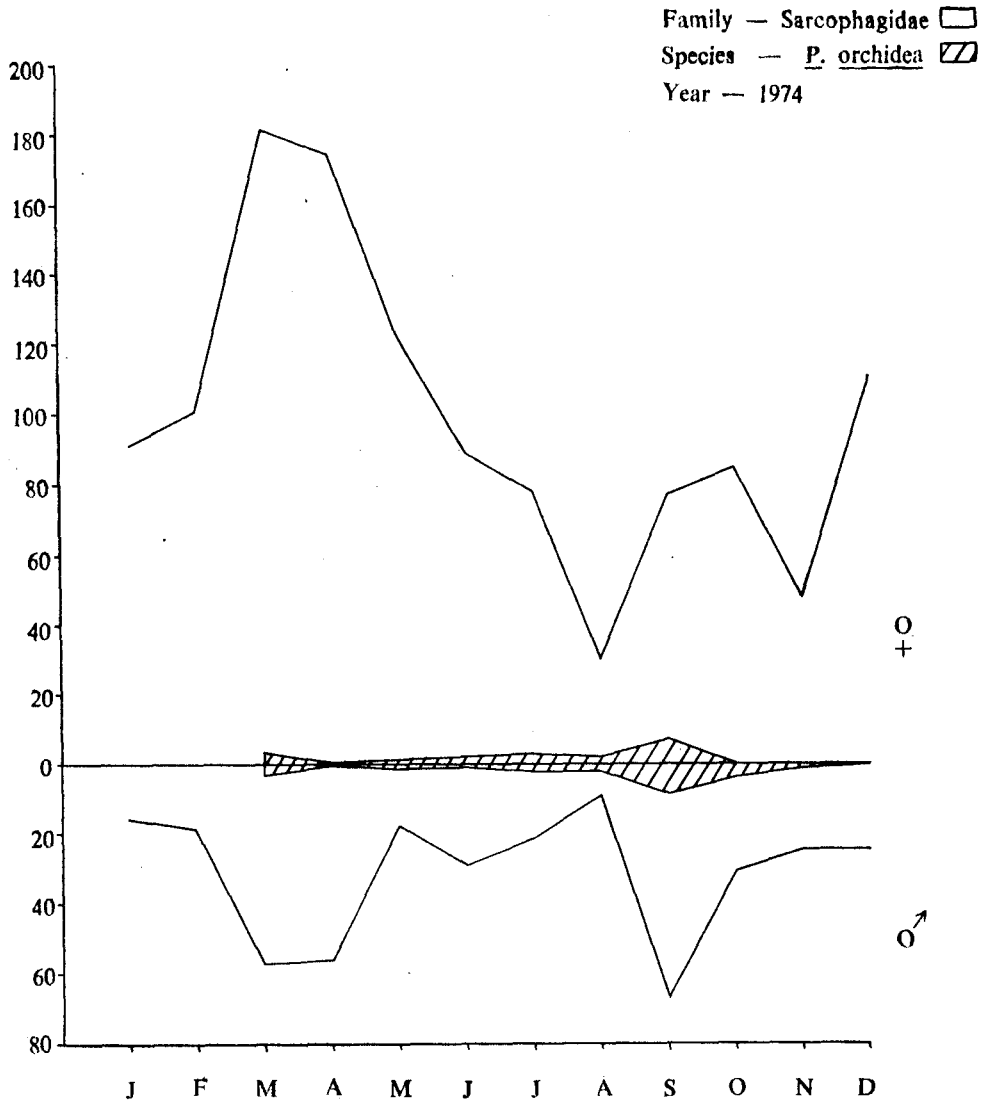

Family — Sarcophagidae
Species — P. orchidea
Year — 1974
200
180
160
140
120
100
80
60
40
20
0
20
40
60
80
♀
♂
J F M A M J J A S O N D

Fig. 38

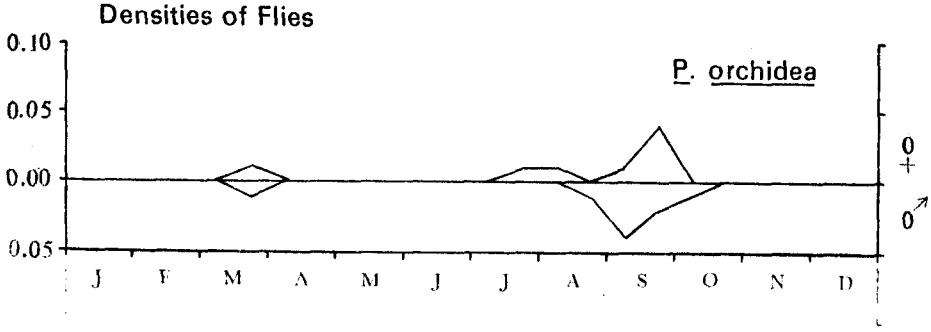

Densities of Flies
P. orchidea
0.10
0.05
0.00
0.05
♀
♂
J F M A M J J A S O N D

Fig. 39

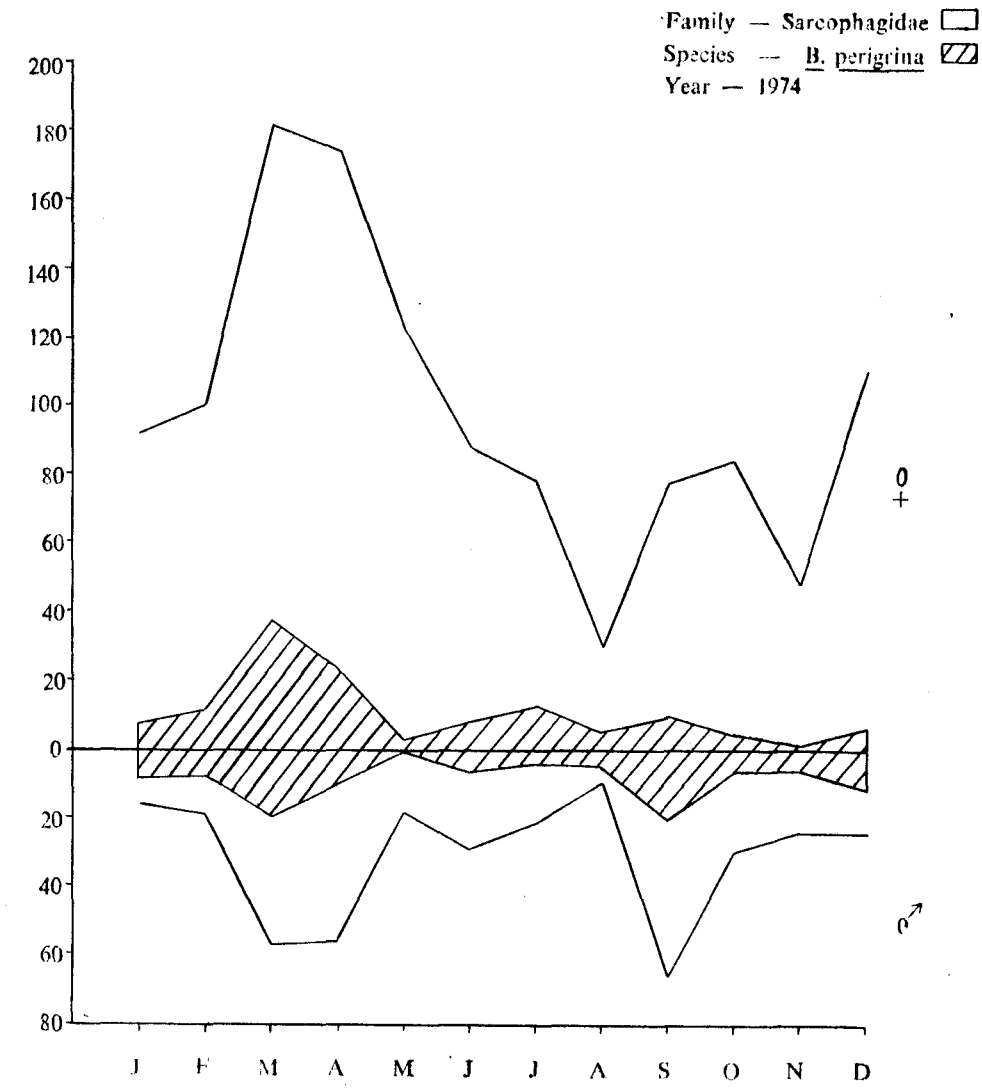

Family — Sarcophagidae
Species — B. perigrina
Year — 1974
200
180
160
140
120
100
80
60
40
20
0
20
40
60
80
♀
♂
J F M A M J J A S O N D

Fig. 40

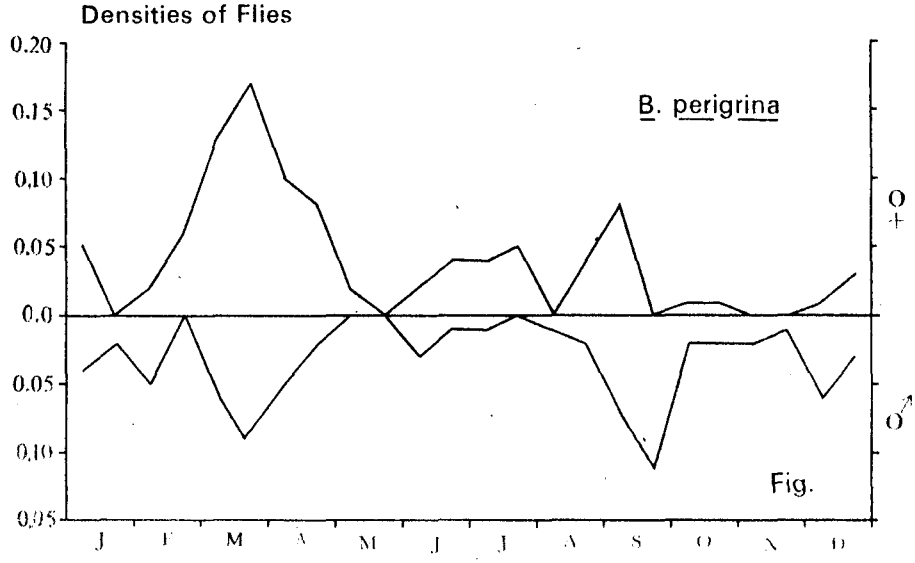

Densities of Flies
0.20
0.15
0.10
0.05
0.0
0.05
0.10
0.15
B. perigrina
♀
♂
J F M A M J J A S O N D

Fig. 41

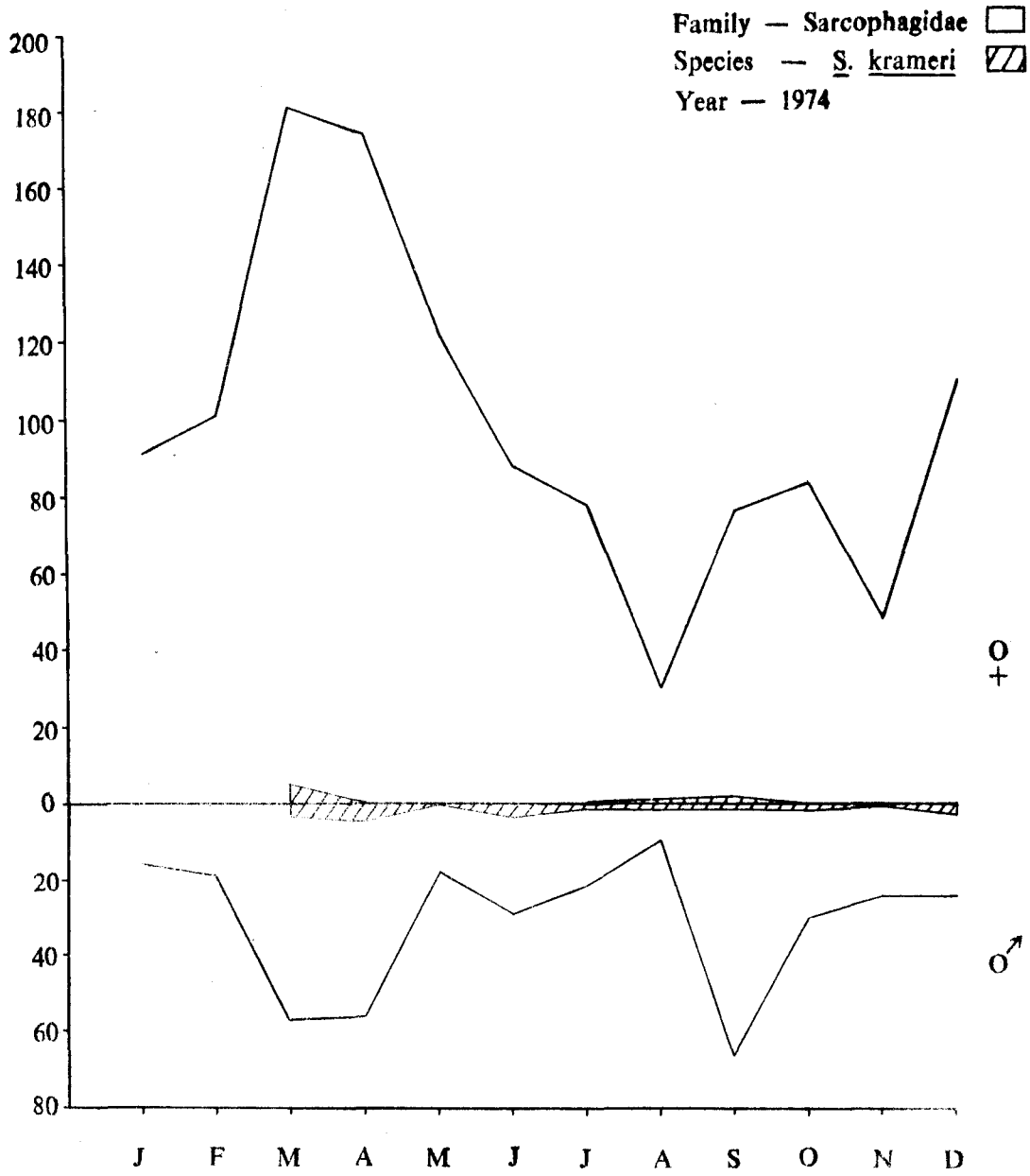

Family — Sarcophagidae
Species — S. krameri
Year — 1974
200
180
160
140
120
100
80
60
40
20
0
20
40
60
80
♀
♂
J
F
M
A
M
J
J
A
S
O
N
D

Fig. 42

CHART NO. 9. Comparative list of flies trapped during the study of seasonal occurrence in Siliguri* and Jalpaiguri.

FAMILY	SPECIES	JALPAIGURI	SILIGURI
CALLIPHORIDAE	*Chrysomya megacephala*	P	P
	Chrysomya rufifacies	P	P
	Hemipyrellia ligurriens	P	P
	Hemipyrellia pulchra	P	P
	Lucilia cuprina	P	P
	Lucilia sericata	P	A
	Lucilia ampullacea	P	A
	Calliphora pattoni	P	A
MUSCIDAE	*Musca domestica*	P	P
	Musca sorbens	P	P
	Musca lucens	P	P
	Musca ventrosa	P	P
	Musca fasciata	P	A
	Musca crassirostris	P	P
	Musca pattoni	P	P
	Ophyra capensis	P	P
	Ophyra leucostoma	P	A
	Ophyra chalcogaster	P	P
	Ophyra nigra	P	P
	Stomoxis calcitrans	P	P
	Synthesomyia nudiseta	P	P
	Dichaetomyia sp	P	P

/Contd....

CHART NO. 1 (Contd.)

FAMILY	SPECIES	JALPAIGURI	SILIGURI
SARCOPHAGIDAE	*Parasarcophaga knabi*	P	P
	Parasarcophaga brevicornis	P	P
	Parasarcophaga ruficornis	P	P
	Parasarcophaga albiceps	P	P
	Parasarcophaga misera	P	P
	Parasarcophaga orchidea	P	P
	Parasarcophaga hirtipes	P	P
	Boettcherisca perigrina	P	P
	Seniorwhitea krameri	P	A
	Harpagophalla kempi	P	A
	Sarcosolomonia crinita	P	A
	Iranihindia martellata	P	A

P denotes presence of fly.

A denotes absence of fly.

*Results of Siliguri taken from Roy and Dasgupta (1975).

Table No. 1 : Calliphorid flies collected with cage traps using raw fish as bait in Jalpaiguri Town, West Bengal during the year January, 1974 to December, 1974.

Seasons		Winter		Spring		Summer		Rainy		Autumn		Season of Dea			
Sl. No. / Species / Months : ⟶	Sex	January	Febru-ary	Maroh	April	May	June	July	August	Septem-ber	October	Novem-ber	Decem-ber	Total sex	T f
1. Chrysomya megacephala	♀	252	94	672	1045	4841	3912	3925	2017	3514	2911	1225	719	25127	
	♂	53	33	87	87	898	834	679	338	928	660	182	107	4886	30
2. Chrysomya rufifacies	♀	4	6	59	56	156	29	65	22	75	139	14	11	616	
	♂	0	2	16	12	27	9	11	5	36	34	8	2	162	
3. Hemipyrellia ligurriens	♀	10	6	90	55	92	47	66	107	96	96	29	24	716	
	♂	0	0	11	11	17	12	17	26	27	17	3	19	160	
4. Hemipyrellia pulchra	♀	0	0	14	3	9	16	23	21	35	6	5	2	134	
	♂	0	0	1	1	2	4	8	9	8	2	0	1	36	
5. Lucilia quorina	♀	4	1	97	23	44	16	10	8	0	0	1	0	204	
	♂	0	0	15	3	6	4	2	4	0	0	0	0	34	
6. Lucilia sericata	♀	1	0	1	0	1	2	2	0	0	0	0	0	7	
	♂	1	0	0	0	0	2	0	0	0	0	0	0	3	
7. Calliphora pattoni	♀												1	1	
	♂												0	0	
8. Lucilia ampullacea	♀					2								2	
	♂														
Total sex monthly:	♀	271	107	953	1180	5125	4022	4091	2175	3720	3152	1274	757		
	♂	54	35	130	114	950	865	717	382	999	713	193	129		
Total Flies monthly:		325	142	1063	1294	6075	4887	4808	2557	4719	3865	1467	886		32,0

Table No. 1 : Muscid flies collected with cage traps using raw fish as bait in Jalpaiguri Town, West Bengal during the year January, 1974 to December, 1974.

Sl. No.	Species	Months: → / Sex	Winter: January	Winter: February	Spring: March	Spring: April	Summer: May	Summer: June	Rainy: July	Rainy: August	Autumn: September	Autumn: October	Season of Dew: November	Season of Dew: December	Total sex	Total flies
1.	Musca domestica	♀	7	6	50	564	1864	39	14	7	15	17	9	9	2601	2,86
		♂	1	0	7	66	174	7	3	2	1	0	2	2	265	
2.	Musca sorbens	♀	7	11	7	16	53	15	7	8	27	20	28	6	205	2
		♂	2	0	5	5	19	2	3	4	6	3	4	0	53	
3.	Musca lucens	♀	0	1	16	50	143	31	7	15	123	48	28	34	496	9
		♂	0	0	1	13	4	7	0	2	28	5	11	0	71	
4.	Musca ventrosa	♀	0	0	5	26	15	8	0	0	25	17	0	0	960	
		♂	0	0	2	1	2	0	0	0	0	0	0	0	5	
5.	Musca fasciata	♀	9	44	26	17	8	0	0	0	14	31	9	26	184	
		♂	0	0	0	0	0	0	0	0	0	0	0	0	0	
6.	Musca crassirostris	♀	0	0	0	0	0	3	3	9	3	4	2	0	24	
		♂	0	0	0	0	0	0	0	0	0	0	1	0	1	
7.	Ophyra capensis	♀	0	0	3	0	12	0	0	0	0	0	0	0	15	
		♂	0	0	0	0	0	0	0	0	0	0	0	0	0	
8.	Musca pattoni	♀	0	0	6	10	33	3	6	8	0	1	5	3	75	
		♂	0	0	1	4	8	0	0	3	0	0	0	0	16	
9.	Ophyra chalcogaster	♀	36	43	57	54	109	17	4	2	54	34	5	25	440	
		♂	0	0	0	6	3	0	0	0	0	0	0	1	10	

/Contd....

Continuation sheet of Table I (Muscid flies):

Seasons		Winter		Spring		Summer		Rainy		Autumn		Season of Dew				
Sl. No. / Species	Months:→ / Sex	January	Febru-ary	March	April	May	June	July	August	Septem-ber	Octo-ber	Novem-ber	Decem-ber	Total sex	Total flies	
10. Ophyra leucostoma	♀	3	1	2	6	0	0	0	0	0	2	0	0	14	16	
	♂	0	0	0	2	0	0	0	0	0	0	0	0	2		
11. Ophyra nigra	♀	0	0	0	4	3	0	0	0	0	0	1	5	13	13	
	♂	0	0	0	0	0	0	0	0	0	0	0	0	0		
12. Stomoxis calcitrans	♀	0	0	0	5	0	0	1	0	0	0	2	0	6	6	
	♂	0	0	0	0	0	0	0	0	0	0	0	0	0		
13. Synthesomyia nudiseta	♀	0	0	0	0	2	1	0	0	0	1	0	0	4	4	
	♂	0	0	0	0	0	0	0	0	0	0	0	0	0		
14. Dichaetomyia sp.	♀	4	0	10	0	0	1	0	0	1	0	0	0	16	17	
	♂	0	0	0	0	0	0	0	1	0	0	0	0	0		
Total sex monthly.	♀	66	106	182	750	2242	118	42	49	262	175	89	108	4189	4613	
	♂	3	0	16	97	210	16	6	12	55	8	18	3	424		
Total flies monthly.		69	106	198	847	2452	134	48	61	297	183	107	111	4613		

Table No. 1. Sarcophagid flies collected with cage traps using raw fish as bait in Jalpaiguri Town, West Bengal, during the year January 1974 to December 1974.

Seasons		Winter		Spring		Summer		Rainy		Autumn		Season of Dew			
Sl. No. / Species.	Sex. / Months: →	January	February	March	April	May	June	July	August	September	October	November	December	Total sex	Total flies
1. Parasarcophaga knabi	♀	4	3	44	46	12	10	12	6	13	24	15	2	191	274
	♂	5	5	13	23	1	6	8	0	8	5	9	0	83	
2. Parasarcophaga brevicornis	♀	49	47	29	41	31	20	22	7	16	13	9	58	342	357
	♂	0	0	3	0	0	0	0	1	3	0	3	5	15	
3. Parasarcophaga ruficornis	♀	6	16	8	10	25	6	1	1	14	18	12	17	134	145
	♂	0	0	1	0	0	0	0	0	10	0	0	0	11	
4. Parasarcophaga albiceps	♀	9	13	45	39	42	36	25	8	13	19	4	18	271	340
	♂	0	2	10	11	9	7	6	0	6	13	1	4	69	
5. Parasarcophaga misera	♀	16	11	10	15	8	6	3	0	3	5	6	9	92	132
	♂	2	5	4	3	7	2	1	0	10	0	5	1	40	
6. Parasarcophaga orchidea	♀	0	0	3	0	1	2	3	2	7	0	0	0	18	39
	♂	0	0	3	0	1	1	2	2	8	3	1	0	21	
7. Parasarcophaga hirtipes	♀	0	0	0	0	0	0	0	0	0	0	0	0	0	9
	♂	0	0	0	5	0	3	0	0	0	1	0	0	9	
8. Boettcherisca peregrina	♀	7	11	37	23	3	8	12	5	9	4	1	6	126	226
	♂	8	7	19	10	0	6	3	5	20	6	5	11	100	
9. Seniorwhitea krameri	♀	0	0	5	0	0	0	0	1	2	0	0	0	8	24
	♂	0	0	3	4	0	3	1	1	1	1	0	2	16	
10. Harpagophalla kempi	♀	0	0	0	0	0	0	0	0	0	0	0	0	0	3
	♂	0	0	1	0	0	1	0	0	0	0	0	1	3	
11. Sarcosolomonia erinita	♀	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	♂	1	0	0	0	0	0	0	0	0	1	0	0	2	
12. Iranihindia martellata	♀	0	0	0	0	0	0	0	0	0	1	1	0	2	2
	♂	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total sex monthly.	♀	91	101	181	174	122	88	79	30	77	84	48	110	1184	1553
	♂	16	19	57	56	18	29	21	9	66	30	24	24	369	
Total flies monthly.		107	120	238	230	140	117	99	39	143	114	72	134		1553

Table No. 2: Collection of flies with cage traps using raw fish as bait in Jalpaiguri Town during the year January 1974 to December 1974.

Season	Sex	Family			TOTAL
		Calliphoridae	Muscidae	Sarcophagidae	
Summer	Female	7832	2588	244	10664
	Male	1544	255	66	1865
	Total	9376	2843	310	12529
Rainy Season	Female	7040	119	129	7288
	Male	1238	17	32	1287
	Total	8278	136	161	8575
Autumn	Female	6689	359	150	7198
	Male	1679	49	92	1820
	Total	8368	408	242	9018
Season of Dew	Female	2974	241	128	3343
	Male	498	21	49	568
	Total	3472	262	177	3911
Winter	Female	703	173	206	1082
	Male	127	5	40	172
	Total	830	178	246	1254
Spring	Female	1569	709	327	2605
	Male	195	77	90	362
	Total	1764	786	417	2967
TOTAL SEX:	Female	26807	4189	1184	32180
	Male	5281	424	369	6074
	Total	32088	4613	1553	38254

Table No. 3 : Fortnightly densities of flies* collected with cage traps using cow dung as bait in Jalpaiguri Town during the year January'74 to December'74.

FAMILY	Species	Sex	MONTHS																					
			January		February		March		April		May		June		July		August		September		October		November		December	
			1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
CALLI PHORI DAE	Chrysomya megacephala	♀	1.19	.90	.48	.30	2.43	3.16	4.70	4.00	10.55	29.80	17.09	15.50	17.82	14.68	9.17	10.05	15.51	17.95	16.21	11.44	6.44	5.21	3.57	3.27
		♂	.21	.22	.15	.11	.44	.28	.38	.34	2.64	4.84	4.25	2.69	3.55	2.30	1.54	1.67	4.60	4.22	4.30	1.98	1.04	.68	.57	.44
	Chrysomya rufifacies	♀		.02	.02	.02	.08	.40	.01	.45	.47	.65	.13	.10	.37	.16	.07	.13	.20	.30	.50	.81	.08	.04	.06	.03
		♂			.01		.03	.10	.01	.08	.07	.15	.05	.02	.06	.02		.03	.15	.20	.20	.11	.01	.03		
	Musca sorbens	♀	.03	.05	.03	.01	.24	.50	.15	.28	.31	.45	.29	.10	.31	.23	.38	.43	.37	.30	.72	.19	.18	.09	.05	.17
		♂					.02	.06	.02	.06	.06	.07	.06	.03	.10	.03	.15	.09	.16	.09	.09	.06		.02	.14	.03
	Musca nebulo	♀					.01	.10		.01	.03	.04	.06	.06	.12	.06	.11	.08	.07	.25	.04		.04		.01	
		♂												.08	.04	.08	.05	.02	.02	.04						
	Musca sorbens	♀	.01	.01			.08	.72	.07	.11	.14	.22	.09	.04	.05	.03	.04	.02								
		♂					.02	.10		.02	.01	.08	.02				.01	.01								
MUSCIDAE	Musca domestica	♀	.02	.03	.01	.03	.20	.20	3.04	1.69	.35	15.17	.19	.13	.05	.05	.01	.04	.09	.04	.10	.05	.08	.01	.04	.05
		♂					.03	.02	.34	.20	.05	1.37	.02	.03		.01								.01		
	Musca sorbens	♀	.02	.03	.05	.04	.02	.05	.07	.09	.11	.32	.07	.05	.02	.03	.04	.02	.09	.16	.07		.16	.10	.01	.03
		♂		.01				.04	.01	.02	.04	.11				.01	.01	.01	.01	.05		.01	.02			
	Musca lucens	♀					.05	.08	.23	.18	.40	.79	.10	.15	.50	.02	.04	.09	.55	.63	.20	.24	.11	.15	.08	.23
		♂							.06	.06	.01	.01	.04	.01					.17	.09	.04			.09		
	Musca vetustissima	♀					.04		.10	.10	.02		.02	.04					.15	.08	.11	.04				
		♂					.01				.01															
	Musca nebulo	♀					.01	.03	.03	.03	.25	.03		.02	.02	.02	.01	.05					.03			.01
		♂							.01	.01	.06							.02								
	Ophyra chalcogaster	♀	.11	.10	.13	.22	.25	.21	.24	.20	.11	.79	.09	.05	.02			.01	.17	.34	.08	.25	.01	.02	.06	.17
		♂							.05			.02														
	Pseudosarcophaga knabi	♀	.01	.01	.01		.12	.24	.24	.14	.05	.04	.05	.05	.05	.05	.01	.03	.08	.05	.15	.07	.07	.06		.01
		♂	.02	.01	.03		.04	.06	.10	.09			.02	.02	.02	.04			.04	.02	.04		.05	.02		
	Pseudosarcophaga portschinskii	♀	.25	.15	.21	.17	.11	.12	.18	.15	.14	.11	.09	.07	.07	.10	.03	.02	.10	.04	.09	.02	.04	.03	.31	.23
		♂						.01												.02				.02		.04

Table No. 3 : Fortnightly densities of flies* collected with cage traps using raw fish as bait in Jalpaiguri Town during the year January'74 to December'74.

FAMILY	Species	Sex	MONTHS																							
			January		February		March		April		May		June		July		August		September		October		November		December	
			1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
SAR	Paracarcophaga ruficornis	♀		.04	.10	.03	.05	.05	.05	.03	.11	.09	.04						.02	.10	.12	.04	.04	.06	.04	.11
		♂																	.01	.07						
CO	Paracarcophaga albiceps	♀	.02	.05	.07	.03	.18	.19	.21	.10	.16	.18	.10	.11	.10	.10	.03	.03	.01	.10	.10	.07		.03	.08	.08
PHA		♂			.01		.03	.05	.05	.04	.05	.04	.05		.03	.01			.02	.02	.07	.04			.03	
SI	Paracarcophaga misera	♀	.08	.05	.04	.05	.01	.06	.05	.07	.01	.05	.05	.01	.02				.02		.03		.01	.03	.02	.05
		♂	.01			.05		.02	.01		.20	.03		.01					.07	.01			.01	.02		
	Paracarcophaga orchidea	♀						.01								.01	.01		.01	.04						
		♂						.01										.01	.04	.02	.01					
	Boettcherisca peregrina	♀	.03		.02	.05	.13	.17	.10	.08	.02		.02	.04	.04	.05		.04	.08		.01	.01			.01	.03
		♂	.04	.02	.05		.06	.09	.05	.02			.03	.01	.01		.01	.02	.07	.11	.02	.02	.02	.01	.06	.03

*Only communicative and accommunicative flies have been considered.

Table No. 4. Collection of Calliphorid, Muscid and Sarcophagid flies with fish-baited traps in Jalpaiguri Town in areas with different illumination.

FAMILY	Species	Sex	AREA						TOTAL	
			Sunny area		Canopy area		Shady area			
			Total	%	Total	%	Total	%		%
CALLIPHORIDAE	Chrysomya megacephala	Female	372	53.06	184	26.24	81	11.55	637	90.87
		Male	44	6.27	16	2.28	4	0.57	64	9.12
	Total:-		416	59.34	200	28.53	85	12.12	701	
	Chrysomya rufifacies	Female	8	57.14	0	-	1	7.14	9	64.28
		Male	4	28.57	1	7.14	0	-	5	35.71
	Total:-		12	85.71	1	7.14	1	7.14	14	
	Hemipyrellia ligurriens	Female	5	7.46	32	47.76	10	14.92	47	70.14
		Male	1	1.49	12	17.91	7	10.44	20	29.85
	Total:-		6	8.95	44	65.67	17	25.37	67	
	Hemipyrellia pulchra	Female	0	-	1		0	-	1	
		Male	0	-	0		0	-	0	
	Total:-		0	-	1		0	-	1	
	Grand Total:-		434	55.42	246	31.41	103	13.15	783	
MUSCIDAE	Musca domestica	Female	18	34.61	8	15.38	21	40.38	47	90.38
		Male	3	5.76	1	1.92	1	1.92	5	9.61
	Total:-		21	40.38	9	17.30	22	42.30	52	
	Musca lucens	Female	0	-	2	20.0	7	70.0	9	90.0
		Male	0	-	0	-	1	10.0	1	10.0
	Total:-		0	-	2	20.0	8	80.00	10	
	Musca sorbens	Female	17	25.37	19	28.35	19	28.35	55	82.08
		Male	4	5.97	4	5.97	4	5.97	12	17.91
	Total:-		21	31.34	23	34.32	23	34.32	67	
	Musca ventrosa	Female	5	71.42	2	28.57	0	-	7	
		Male	0	-	0	-	0	-	0	
	Total:-		5	71.42	2	28.57	0	-	7	
	Musca pattoni	Female	2	50.00	1	25.00	0	-	3	75.00
		Male	0	-	0	-	1	25.00	1	25.00
	Total:-		2	50.00	1	25.00	1	25.00	4	

Continuation sheet of Table No. 4.

FAMILY	Species	Sex	AREA						TOTAL	
			Sunny area		Canopy area		Shady area			
			Total	%	Total	%	Total	%		%
Muscidae	Musca crassirostris	Female	1	-	0	-	0	-	1	
		Male	0	-	0	-	0	-	0	
	Total:-		1	-	0	-	0	-	1	
	Ophyra chalcogaster	Female	1	-	0	-	0	-	0	
		Male	0	-	0	-	0	-	0	
	Total:-		1		0	-	0	-	1	
	Grand Total:-		51	35.91	37	26.05	54	38.02	142	
Sarcophagidae	Parasarcophaga knabi	Female	4	57.17	1	14.28	1	14.28	6	85.71
		Male	0	-	1	14.28	0	-	1	14.28
	Total:-		4	57.17	2	28.57	1	14.28	7	
	Parasarcophaga ruficornis	Female	0	-	3	60.00	2	40.00	5	
		Male	0	-	0	-	0	-	0	
	Total:-		0	-	3	60.00	2	40.00	5	
	Parasarcophaga brevicornis	Female	6	50.00	2	16.66	4	33.33	12	
		Male	0	-	0	-	0	-	0	
	Total:-		6	50.00	2	16.66	4	33.33	12	
	Parasarcophaga albiceps	Female	2	33.33	2	33.33	2	33.33	6	
		Male	0	-	0	-	0	-	0	
	Total:-		2	33.33	2	33.33	2	33.33	6	
	Boettcherisca peregrina	Female	0	-	3	75.00	0	-	3	75.00
		Male	0	-	1	25.00	0	-	1	25.00
	Total:-		0	-	4		0	-	4	
	Seniorwhitea krameri	Female	1	50.00	0	-	0	-	1	50.00
		Male	0	-	1	50.00	0	-	1	50.00
	Total:-		1	50.00	1	50.00	0	-	2	
	Parasarcophaga orchidea	Female	2		0	-	0	-	2	
		Male	0	-	0	-	0	-	0	
	Total:-		2		0	-	0	-	2	
	Parasarcophaga misera	Female	0	-	0	-	1		1	
		Male	0	-	0	-	0	-	0	
	Total:-		0	-	0	-	1		1	
	Grand Total:-		15	38.46	14	35.89	10	25.64	39	
	Total Flies:-		500	51.86	297	30.80	167	17.32	964	

Table No. 5 : Total number of flies trapped in Jalpaiguri Town using different types of attractants in May and September 1974.

Sl. No.	Species.	Sex.	Baits																			
			Banana		Pine apple		Jack fruit		Mango		Mustard oil flake + corn-flour		Molasses		Human faeces		Cow dung		Rotten egg		Meat		Mix.	
1.	Chrysomya megacephala	Female	4	7	8	15	12	22	31	56	1	1	0	0	0	0	0	0	10	10	6	7	607	607
		Male	3		5		10		25		0		0		0		0		0		1		597	
2.	Chrysomya rufifacies	Female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	6
		Male	0		0		0		0		0		0		0		0		0		0		2	
3.	Lucilia cuprina	Female	1	3	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	1	9	11
		Male	2		0		0		0		0		0		0		0		1		0		2	
4.	Lucilia sericata	Female	0	0	0	0	0	0	0	0	0	0	0	0	8	9	5	5	0	0	0	0	5	5
		Male	0		0		0		0		0		0		1		0		0		0		0	
5.	Lucilia sp.	Female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	5	6	2	2	4	5
		Male	0		0		0		0		0		0		0		0		1		0		1	
6.	Musca sorbens	Female	1	1	7	10	10	13	21	25	6	23	1	1	2	2	0	0	14	14	6	6	14	16
		Male	0		3		3		4		17		0		0		0		0		0		2	
7.	Musca vomitoria	Female	6	17	5	5	7	7	48	90	33	90	5	7	0	0	1	1	28	30	0	2	36	47
		Male	11		0		0		48		57		2		0		0		2		2		11	
8.	Musca lusoria	Female	3	3	4	7	11	15	8	29	3	7	3	3	11	12	8	10	2	2	1	1	6	6
		Male	0		3		4		21		2		0		1		2		0		0		0	
9.	Musca sp(1)	Female	0	0	2	2	4	4	8	14	11	13	2	2	0	0	0	0	0	0	0	0	3	3
		Male	0		0		0		6		2		0		0		0		0		0		0	
10.	Musca sp(2)	Female	1	1	0	0	2	2	15	15	3	3	0	0	2	2	3	3	0	0	0	0	0	0
		Male	0		0		0		0		0		0		0		0		0		0		0	
11.	Musca domestica	Female	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
		Male	0		0		0		0		0		0		0		0		0		0		0	
12.	Ophyra chalcogaster	Female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	23	23
		Male	0		0		0		0		0		0		0		0		0		0		0	
13.	Stomoxys calcitrans	Female	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0
		Male	0		0		0		0		0		0		0		0		0		0		0	

/Contd.....

Table No. 5 : Total number of flies trapped in Jalpaiguri Town using different types of attractants in May and September 1974.

Sl. No.	Species.	Sex.	Baits																					
			Banana		Pine apple		Jack fruit		Mango		Mustard oil flake & cow-dung		Molasses		Human faces		Cow-dung		Rotten egg		Meat		Fish	
14.	Parasarcophaga knabi	Female	0	0	0	1	2	2	1	1	0	0	0	0	0	0	0	0	2	3	2	5	9	13
		Male	0		1		0		0		0		0		0		0		1		3		4	
15.	Parasarcophaga kuscicornis	Female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	0	0	20	21
		Male	0		0		0		0		0		0		0		1		0		0		1	
16.	Parasarcophaga ruficornis	Female	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	2	2	0	0	1	1
		Male	0		1		0		0		0		0		0		0		0		0		0	
17.	Parasarcophaga albiceps	Female	0	0	0	0	0	2	2	2	2	2	1	1	1	1	4	5	2	4	4	4	8	8
		Male	0		0		2		0		0		0		0		1		2		0		0	
18.	Parasarcophaga misera	Female	0	0	0	0	0	0	0	1	0	1	0	0	0	3	0	0	4	6	0	1	3	9
		Male	0		0		0		1		1		0		3		0		2		1		6	
19.	Parasarcophaga crenidea	Female	0	0	2	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Male	0		1		1		0		0		0		0		0		0		0		0	
20.	Boettcherisca peregrina	Female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
		Male	0		0		0		0		0		0		0		0		1		0		1	
21.	Sarcophaga kiomeri	Female	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
		Male	0		0		0		0		0		1		0		0		0		0		1	
22.	Harpagophalla kenai	Female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
		Male	0		0		0		0		0		0		0		0		2		0		0	
23.	Pigmentia calicifera	Female	0	0	0	0	0	0	0	1	0	2	0	0	1	3	1	3	0	0	0	0	0	0
		Male	0		0		0		1		2		0		2		2		0		0		0	
	CALLIPHORIDS:			10		13		22		56		1		0		10		6		17		10		684
	MUSCIDS:			22		24		41		171		127		13		17		15		49		9		95
	SARCOPHAGIDS:			0		5		6		5		5		2		7		9		20		10		54
	TOTAL FLIES:	Female	16	32	28	42	49	69	126	232	72	133	14	15	27	34	24	30	74	86	22	29	747	833
		Male	16		14		20		106		61		1		7		6		12		7		86	

Chapter - III

DIURNAL ACTIVITY OF SYNANTHROPIC FLIES

INTRODUCTION

Literature extant on the subject reveals that there is a definite diurnal rhythm exhibited by different species of flies in different parts of the world. The rhythm manifests itself in two definite peaks of activity during day time. The activity is however subject to influence exerted by various external and internal factors. The peaks of activity and, factors influencing such activity are as follows:-

Activity curve :

Diurnal activity curve may be of three types viz., unimodal, bimodal or trimodal curve.

Unimodal activity curve was observed in Musca autumnalis in Denmark (Hammer, 1941). A single peak around noon was also reported by Nuorteva (1959b) in Finland. Phormia terraenovae also exhibited unimodal activity curve on 7th August and 12th August 1957, in Moscow (Tamarina and Zhelesova, 1962). Similar unimodal activity curve of P. terraenovae was also observed in Finland (Nuorteva, 1966a). Nuorteva and Hackman (1970) again observed unimodal flight curve in case of a Drosophilid fly, Chymomyza costata in subarctic condition. Blowflies on the Ailigas hill showed unimodal activity curve (Hedström and Nuorteva, 1971).

Bimodal activity curve for Musca domestica was observed in Japan between May and September (Shinoda and Ando, 1935). Bimodal activity curve of M. domestica was also observed in Sudan (Parker, 1962). Suenaga (1963) also noted the bimodal activity of M. domestica in Japan, one peak occurring in the morning and the other in the afternoon. Drosophila subobscura showed two peaks of activity, one in darkness and other at dawn, in Rothamstead, England (Taylor and Kalmus, 1954). Suenaga (1963) also noticed three peaks of activity, two in September and October, and one in November, for Chrysomya megacephala, in Japan.

Unimodal type of flight curve occurs in an area where the ambient temperature at no time of the day exceeds the thermal preferendum of insects in general and flies in particular. Thus unimodal type of flight curve was the characteristic feature of flies in subarctic conditions in North Finland (Nuorteva, 1965a,b) as well as in South Finland (Nuorteva, 1959b) and in England (Lewis and Taylor, 1965). But in more southern latitudes such as Samarkand (Sychevskaya, 1962), Azarbaijan (Lineva, 1964), Chechoety in East Pamir (Sychevskaya and Shaidurov, 1965), Isahaya, Japan (Suenaga, 1963) and in Calcutta (Das et al., 1978-79) unimodal type of peak was not so sharp because of higher mean temperature.

Factors influencing activity curve :

Various factors have been reported to influence the peak or peaks of activity of blowflies. The following is a brief account of such factors :

In England, Harker (1961) noted that the intensity of light was a powerful factor and could influence diurnal rhythm of flies. Parker (1962) observed that the sudden variation in intensity of illumination in the day or night had pronounced and immediate effect on the activity of Musca domestica in Sudan. In Japan, activity of flies began when light intensity reached an illumination between 400 - 3000 lux (Suenaga, 1963). Nuorteva (1965a) noted that even in favourable conditions of temperature, light intensity had a controlling effect on fly activity, and that light itself might act as a controlling factor (Nuorteva, 1965b). Effect of light intensity on the activity of Phormia terraenovae in Spitsbergen was noted by Remmert (1965). On the contrary, a subarctic Drosophilid fly, Chymomyza costata showed inhibition of activity in bright sunlight (Nuorteva and Hackman, 1970). Hanski and Nuorteva (1975) noted that differences in the activity curve on the canyon (with dense shady vegetation) and on a small fell (sparse vegetation) was due to stronger wind and sunshine on the fell.

Activity of Musca autumnalis occurred in warm weather in Denmark (Hammer, 1941). Nuorteva (1959b) noted that

coldness inhibited the activity of blowflies in Finland. Harker (1961) observed that diurnal rhythm in insects could be initiated by temperature change. Parker (1962) showed that low temperature resulted in inhibition of endogenous activity which further reduced the responsiveness of Musca domestica to the slight increase in light intensity. In Moscow, rise of temperature to 28°c resulted in the change of activity curve of Phormia terraenovae (Tamarina and Zheleznova, 1962). In Japan, Suenaga (1963) observed that temperature (above 8°c and below 15°c) itself became the controlling factor. In Finland, low temperature in the island inhibited the percentage of occurrence of flies as compared to what was found on the shore-side village.

Activity of flies might depend on various combined effect of climatological factor.

Taylor and Kalmus (1954) noted that bimodality of Drosophila subobscura occurred apparently due to the increased visual efficiency of flies but the real ecological factor was the humidity. Schoof and Savage (1955) showed that the flies of a particular area available for trappings were influenced by temperature and humidity but Stewart and Roessler (1942) were unable to demonstrate any such correlation between the number of flies and temperature and humidity. Schulee (1959) experimentally proved that the blowflies were much more active at high temperature and low relative humidity.

Activity of H. binotata, in the subarctic North Finland, intimately depended on temperature, humidity and cloudiness (Nuorteva, 1965a). Activity curve of P. terraenovae, in North Finland, was influenced by temperature and humidity (Nuorteva, 1966a).

The activities of flies at higher altitude were studied by different workers in relation to climatological factors.

Macleod and Donnelly (1958), in southern uplands of Scotland, found that the activities of P. terraenovae, Calliphora vomitoria and Lucilia caesar were likely to be influenced by eco-climatic and other physical conditions. The activities of flies at high altitude was studied and discussed by Mani (1962). According to him Dipteran flies in the Alps showed maximum activity in the morning, two hours after sunrise, and again in late after-noon when the wind speed was sufficiently high. He further stated that the dominant factors influencing the activities of flies at high altitudes were low atmospharic pressure, cold, high wind speed, aridity, high intensity of solar radiation and snow covers. On the Ailigas hill, North Finland (Nuorteva, 1964b) maximum number of blowflies occurred in Tundra zone and in the thin Birch Scrub Zone but lesser number of these flies were present on the vegetation-less top of the hill and few in the dense Birch forest. Hedström and Nuorteva (1971)

found that the blowflies on the Ailigas hill reached its peak of abundance near the timber line in the shady Birch Scrub and their number gradually decreased with elevation. The experimental findings of Haneki and Nuorteva (1975) on the canyon (with dense shady vegetation) of Kevo river and on the east slope of a small fell (sparse vegetation) on subarctic Northern Finland showed the occurrence of unimodal periodicity curve in the canyon but bimodal periodicity curve on the fell in respect of Scatophaga furcata, Helina lactifica, Hydroporia conica and Liopiophila varipes.

Diurnal activity of flies is not only influenced by external factors alone but also by internal or endogenous factors. Harker (1958) define endogenous rhythm as one which persisted in constant environmental conditions and when this condition fluctuated it affected or determined the form of the rhythm. He pointed out that diurnal rhythm in general is more evident in light than in darkness. Bruce and Pittendrich (1957) drew attention to similar tendency occurring in animals and in insects in particular.

Experimental observations of Barton-Browne and Evans (1960) showed that Phormia regina became more active after 24 hrs of starvation than those flies which were fed on glucose, fructose and mannose.

Nuorteva (1966a) noted that increased number of Phormia terraenovae in North Finland, on the meteriologically

poor day was due to decrease in the endogenous drive as a result of unsatiated hunger and thirst of flies, who could not come out the previous day which was meteriologically poorer. That the level of locomotor activity of flies was the function of the volume of the crop was also experimentally proved (Dethier and Bodenstein, 1958; Evans and Barton-Browne, 1960; Evans, 1961; Dethier and Evans, 1961 and Barton-Browne, 1964).

Insects in general and flies in particular have been found to have different limit of tolerence to temperature. Tamarina and Zhelezova (1962) experimentally proved that bimodality in the flight curve of Phormia terraenovae developed only when the temperature at a particular time of the day exceeded the thermal preferendum of the above species. It was shown by Amosova (1962) that the increase in ambient temperature beyond the level of tolerence for a fly species might elevate its body temperature to a lethal level resulting in its inactivity. The studies of Sychevskaya and Shaidurov (1965) in East Pamir with P. terraenovae corroborated the above findings. They showed that under the influence of high solar radiation body temperature of P. terraenovae might exceed the atmospheric temperature by 11° to 22°c on a sunny day and 3° to 8°c even on a cloudy day.

Very little work in this respect has been done in India.

Ilse and Mulherkar (1954) investigated the diurnal fluctuation in mating activity of M. domestica nebulo under normal condition as well as under reverse illumination at Poona. They noticed the occurrence of two peaks of diurnal activity, one between 6.30 am to 9 am and the other between 11.30 am to 3.30 pm. They also found that the mating activity of M. domestica adults which had been kept in darkness during the day and were illuminated at night was confined to the latter period.

Deoras and Ranade (1957) studied times of oviposition, hatching and pupal emergence of M. domestica nebulo at Poona and noted that oviposition took place early in the morning or late in the evening and emergence of imago occurred in the early morning.

While working on the flying activities of Chrysomya megacephala and C. rufifacies Das et al., (1978,'79) found that both the flies exhibited bimodal diurnal peak (between 9 to 11 hrs and 14 to 15 hrs) in summer and unimodal peak (between 12 to 13 hrs) in winter. They further noted that the activity of these flies reached its zenith at comparatively high temperature and low relative humidity.

Present investigation was undertaken in order to ascertain the diel periodicity of some medically important synanthropic flies of the study area. These flies are well-known carriers of different types of pathogenic organisms and

are causative agents of myiasis in man and domesticated animals. Results of the present work will help the future worker to know the peak hours of activity of different fly species, and this in turn will help the work of eradication of flies and maintenance of sanitary conditions.

MATERIAL AND METHOD

Simultaneous trappings with fish-baited traps were made in the heart of Jalpaiguri Town for studying the diel activity of flies. The experiments were performed on seven different days in June and September, when the flies in general are most abundant in nature. Traps (described in chapter IV) were operated on all the experimental days from 5 hrs to 19 hrs in the trapping sites, in such a position that sunlight and air were available to the traps from all directions. Four traps, each baited with 250 gm of raw-fish, were used on every experimental day except on 28th June 1975, when jackfruit were used in all the traps in lieu of fish. Traps were released every hour on each experimental day to find out the diel periodicity of flies.

Trapping site i.e., the Fire Brigade Compound is situated on the south-eastern part of Jalpaiguri Town in the midst of thickly populated locality. The compound occupies an area of 4180.64 sq.m. and was covered with grasses, seasonal herbs and shrubs. The three traps were positioned at an approximate distance of 15 m from each other to ensure that the catch of the trap might not be influenced by the proximity of another trap.

Mean temperature, relative humidity and rainfall of the site were recorded (see table 8). Relevant data was also obtained from the Regional Meteorological Centre, Alipore,

Calcutta, for comparison and correction (data shown in appendix VI).

Experiments to ascertain the influence of feeding, mating, oviposition and pupal emergence on the diurnal activity of some flies (Chrysomya megacephala, C. rufifacies, Musca domestica, M. sorbens and M. lucens) were also performed under natural conditions with captured wild flies in the courtyard of a house located at a distance of 50 m on the north-eastern side of the Fire Brigade compound.

Wild flies were caught from the nature, identified and placed in different observation boxes. Observation box was a cubical cage (30 cm^3), walls of which were made of fine mosquito net. Floor and roof of the cage were made of replaceable wooden plank. On one wall of the cage there was a circular hole closed with a cloth cover. Through this hole food and drink could be supplied to the experimental flies.

Flies were supplied with glucose water, chopped liver, sliced banana and milk soaked in cotton on separate petridishes as food and drink.

Four separate cages were employed for each species of flies in these experiments which spread over seven days' time in the month of May '78. Each cage contained thirty wild flies of each species (males and females in the ratio of 1 : 1). Experiments began on each day one and half hour before sunrise and continued half an hour after sunset. Observations were

made at an interval of every two hours.

Third stage larvae of the experimental flies were taken and put into different glass jars containing moist sawdust for study of pupal emergence. Larvae were reared and put into different glass jars in such a fashion that the emergence of imago took place regularly.

OBSERVATION

Peaks of activity :

The flies as a whole were found to start activity at 4 hrs and the activity continued upto 19 hrs in June (begining of rainy season), whereas in September (autumn) the activity started at 5 hrs and continued upto 18 hrs. Flies were found to form two peak periods of activity, one before noon time and the other in afternoon, in both June and in early September. In the last week of September (late rainy season), only one peak of activity was noticed. Flies exhibited intense activity between 9 hrs to 11 hrs, and again from 14 hrs to 16 hrs, on all the days, excepting on 28.9.75* when the peak activity was observed around 14 hrs. Rapid increase in the activity of flies occurred when the temperature ranged between 28° to 33.5°c and relative humidity was below 76%.

Calliphoride were found to be active at hours with high temperature when the activity of Muscid flies diminished considerably. Chrysomya megacephala, the most dominant species in the study area, started signs of activity when the temperature crossed 25°c, and the maximum activity of flies was recorded when the temperature was above 31°c and relative humidity was below 76%. In June and in early September this fly showed two peak periods of activity, i.e., 9 hrs to 10 hrs,

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* On this day jackfruit was used as bait, unlike on other days of experiment when fish was used as bait.

and from 15 hrs to 16 hrs, in June, and 11 hrs and 14 hrs, in early September. In late September, only one peak (14 hrs) was noticed. Chrysomya rufifacies started its activity in June and September, when the temperature crossed 26°c and 27°c respectively. Peak periods of activity of this fly was observed between 10 hrs to 11 hrs and 14 hrs to 15 hrs on all the days, when the temperature and relative humidity ranged between 29°c to 32°c and 75% to 79% respectively. Only this species did not enter the trap when fruit was used as bait. Hemipyrellia ligurriens entered the traps at a temperature of 25°c and their numbers increased when the temperature ranged between 26°c to 30°c. In June this species showed two peaks of activity, one peak before 12 hrs, and the other after 15 hrs, whereas in September two peaks of activity were found to occur before 12 hrs. In other hours of the day this fly was absent.

Muscids showed two peak periods of activity in June (9 hrs to 11 hrs and 15 hrs to 16 hrs) and in early September (9 hrs to 10 hrs and 14 hrs to 15 hrs), but in late September (28.9.75) the peak period of activity was noticed around 14 hrs. Musca domestica in June and September, began its activity when the temperature crossed 25°c. Highest peak of activity was observed when the temperature ranged between 28°c and 32°c and the relative humidity was below 79%. This fly showed two peaks of activity in June (9 hrs to 11 hrs and 14 hrs to 16 hrs) and

in early September (9 hrs to 10 hrs and 14 hrs to 15 hrs), but in late September (28.9.75) peak period of its activity were restricted around 14 hrs. Musca sorbens began to show signs of activity at a temperature of 25°c in June, but in September its activity started at 26°c. The most favourable range of temperature at which this fly showed maximum activity was 28°c to 32°c when relative humidity was below 76%. M. sorbens exhibited two peak periods of activity in June (9 hrs to 11 hrs and 15 hrs to 17 hrs) and in early September (10 hrs and 14 hrs to 15 hrs), but in late September its activity was found to be restricted around 11 hrs. Activity of M. lucens began in June and September, when temperature rose above 26°c and maximum activity was noticed between 28°c to 32.5°c and when relative humidity was between 66% to 81%. This fly showed two peaks of activity, one in June (10 hrs and 16 hrs to 17 hrs) and another in September (10 hrs to 11 hrs and 14 hrs to 15 hrs).

Sarcophagids showed signs of activity, when temporature rose above 25.5°c and was found to be active throughout the day. Their activity increased when temperature rose above 28.5°c and the maximum activity of these flies was noticed in the afternoon when temperature ranged between 29°c to 33°c.

Rainfall inhibited the activity of flies during experimental periods. Activity of M. domestica and Sarcophagid flies ceased completely during the hours of rain. The number of

Calliphorids and Muscid always noticeably increased in hours immediately after rain.

Causes of activity :-

(a) Feeding - All the five species of flies investigated here (Chrysomya megacephala, C. rufifacies, Musca domestica, M. sorbens and M. lucens) showed two peak periods of feeding activity, one in the morning and other in the afternoon period on all the experimental days. The peak period of feeding in both Calliphorids (C. megacephala and C. rufifacies) and Muscids (M. domestica, M. sorbens and M. lucens) were observed between 8.30 hrs to 11 hrs and between 14 hrs to 15 hrs. The morning session of feeding was a prolonged one compared to the afternoon session. Signs of feeding activity started long after sunrise but continued upto sunset. Each feeding period was followed by a brief period of inactivity when the flies were found to clean their mouth parts with legs.

(b) Mating - When the males and the females of species under investigation were put together in cages, males were seen to hover around females in an attempt to mate. The actual mating took place when the males momentarily brought the tip of their abdomen in contact with the abdominal tip of the female. Mating occurred in the morning between 7 hrs to 9 hrs and again in the afternoon between 14 hrs to 19 hrs. Mating activity in all cases ceased half an hour before sunset. M. lucens,

however, ceased above activity more than an hour before sunset. Mating activity was followed by feeding in all the cases and the afternoon session of mating activity was more pronounced than the morning session.

(c) Oviposition - In all cases oviposition took place under experimental condition only once in the day, either in the morning (between 6 hrs to 9 hrs) or in the afternoon (between 16 hrs to 17 hrs). In one of the experimental days (i.e., on 21.5.78) oviposition took place in case of Chrysomya megacephala in both halves of the day, while on other day (i.e., on 20.5.78) these flies oviposited at noon time (12.30 hrs) only. C. rufifacies and M. lucens oviposited only in the morning hours (6 hrs to 7 hrs) whereas C. megacephala, M. domestica and M. sorbens laid eggs either in the morning or in the afternoon hours. The most preferred breeding media for these flies were raw-fish, on which the eggs were always laid on fissures, holes or on the under-surface of fish pieces where they were not fully exposed. In the absence of raw-fish the flies were also found to oviposit on the mixture of cow-dung and mustered oil flakes, or on milk soaked in cotton and even on sliced banana.

Oviposition in all the species were strictly restricted to day-light hours only and no oviposition was observed between the sunset and sunrise.

(d) Pupal emergence - Observations on glass jars containing pupae ready to emerge were made at an interval of every two hours. Emergence of pupae in the present study were restricted only to morning between 6 hrs to 9 hrs. Imago immediately after emergence were found to be whitish in colour with folded wings when they moved only on their legs. Soon the flies unfolded and spread their wings with their hind legs and in the meantime colouration also changed to that of the normal adult. The imago then moved on their wings and started feeding preferably on glucose water and sliced banana, in the experimental case.

Feeding, mating, oviposition and pupal emergence were not noticed during the period of darkness i.e., from sunset to sunrise.

Total number of flies caught in this study of diel periodicity was 21519, comprising of three families viz., Calliphorids, Muscids and Sarcophagids. Calliphorid flies formed the largest bulk (numbering 17503 or 82.10% of the total catch, where females and males were 15714 or 89.77% and 1789 or 10.22% respectively), followed by Muscids (numbering 3413 or 16% of the total catch, in which 2761 or 80.89% and 652 or 19.10% were females and males respectively) and Sarcophagids (numbering 403 or 1.89% of the total catch, in which 252 or 62.53% and 151 or 37.46% were females and males respectively) on all the experimental days.

Calliphorids were represented in the catch by six species of which Chrysomya megacephala (numbering 16865 or 96.35% of the Calliphorids, in which 15256 or 90.45% and 1609 or 9.54% were females and males respectively), Chrysomya rufifacies (numbering 451 or 2.57% of the Calliphorids, in which 319 or 70.73% and 132 or 29.26% were females and males respectively) and Hemipyrellia ligurriens (numbering 138 or 0.78% of the Calliphorids, consisting of 101 or 73.18% and 37 or 26.81% females and males respectively) were the dominant species. Muscids were represented by nine species of which Musca domestica (numbering 1218 or 35.68% of the Muscids, in which 1036 or 85.05% and 182 or 14.94% were the females and males respectively), Musca sorbens (numbering 1553 or 45.50% of the Muscids, in which females and males were 1194 or 76.88% and 359 or 23.11% respectively) and Musca lucens (numbering 474 or 13.88% of the Muscids, consisting of 372 or 78.48% and 102 or 21.51% females and males respectively) were found in abundance. Twelve species of Sarcophagids were trapped in the experimental period in more or less equal numbers.

The diurnal activity of C. megacephala, C. rufifacies, M. domestica, M. sorbens and M. lucens could be studied because of their sufficient numbers in the catches on experimental days.

DISCUSSION

The experimental findings of Schulze (1959) that the activity of blowflies increased at high temperature and low relative humidity, seemed to be true for Calliphorid as well as for Muscid flies in the present study area.

The activity of Calliphorid and Muscid flies investigated here showed their dependence on high temperature and comparatively low relative humidity. These flies exhibited bimodal diel periodicity curve in June (begining of rainy season) and in early September (autumn), and unimodal curve in late September. Sarcophagid flies did not show any discernible pattern of activity because of their small numbers though they were trapped on all the experimental days.

Chrysomya megacephala, C. rufifacies, Musca domestica, M. sorbens and M. lucens in Jalpaiguri and C. megacephala and C. rufifacies in Calcutta showed bimodal flight curve in summer (May in Jalpaiguri and April in Calcutta). In winter (November) unimodality in flight curve of C. megacephala and C. rufifacies was noticed in Calcutta but in Jalpaiguri unimodal curve was obtained in late September in case of all the five species.

In Japan, Suenaga (1963) reported that the activity of C. megacephala in November remained restricted to hours around noon, because low temperature inhibited their activity

at other times of the day. But in Jalpaiguri (C. megacephala, C. rufifacies, M. domestica, M. sorbens and M. lucens) and in Calcutta (C. megacephala and C. rufifacies) the activities were spread over the whole day-light period because of the existence of higher mean temperature throughout the day. Unimodal flight curves of Calliphorid and Muscid flies also occurred in cooler countries like Finland (Nuorteva, 1965,'59b), England (Lewis and Taylor, 1965), Azarbaijan (Lineva, 1964), Chechnya in East Pamir (Sychevskaya and Shaidurov, 1965) and in Japan (Suenaga, 1963) where the temperature around noon hours remained congenial for the activity of these flies. Unimodal curve of activity, therefore is the characteristic of cold climate.

A clear bimodality in flight curve of flies may develop in the hottest time of the season when the temperature exceeds the limit of their tolerance or thermal preferendum (Tamarina and Zhelesova, 1962). The increasing ambient temperature exceeding the thermal preferendum of a given species may elevate its body temperature to a lethal level (see Ameeova, 1962) resulting in its inactivity. The blowflies are able to withstand much higher temperature than any other flies probably due to their reflecting skin surface and thick cuticle (Nuorteva, 1966). This seems to be reason for higher activity of blowflies (C. megacephala and C. rufifacies) in hours when the activities of Muscids (M. domestica, M. sorbens and M.

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lucens) are comparatively lower as seen in the present study. Thermal preferendum for C. megacephala and C. rufifacies in Calcutta was found to be 35°c and 33°c respectively (Das et al., 1978, 1979). Bimodality in the periodicity curve of the above flies did not develop sharply during June and early September because temperature around noon never crossed the limit of thermal preferendum for these flies in the present study area. However, the highest activity of C. rufifacies on 26.6.75, in the afternoon hours when the temperature was above 33°c seemed to indicate that the thermal preferendum of this species in the study area stood higher than 33°c. It is interesting to note that the activity of C. megacephala and C. rufifacies on 26.6.75 (fig. No. 2) dropped sharply at noon though the temperature was below the limit of their tolerance to heat which may be attributed to the rise in their body temperature to a level exceeding the ambient temperature. Similar observations were made by Sychevskaya and Shaidurov (1965) in the case of another blowfly, Phormia terraenovae, in which the body temperature might rise far exceeding the ambient temperature under the influence of high solar radiation on sunny as well as on cloudy days. It is evident that on 26.6.75 the rise in the body temperature of C. megacephala and C. rufifacies must have exceeded their thermal preferendum resulting in their inactivity.

Of the three species of Muscid flies studied here, M. sorbens was able to remain active at a temperature of 33.5°c in which M. domestica and M. lucens showed inactivity. Thus the thermal preferendum for M. sorbens is 33.5°c and for M. domestica and M. lucens is 33°c in the present study area. Bimodality in their flight curve on 26.6.75 developed due to the crossing of their thermal preferendum but on other days the drop in the curve occurred either due to rainfall or cloudiness but not due to the rise of temperature beyond the level of their tolerance. Similar activity pattern was also noticed in C. megacephala and in C. rufifacies in the study area.

It has not been possible to arrive at a definite conclusion regarding the activity of H. ligurriens because of their very low number in the hourly catches during the period of study. However, the activity of this species was noticed during the hours when the temperature was about 29°c.

The study reported here revealed that rainfall and cloudiness hindered the activity of C. megacephala, C. rufifacies, M. domestica, M. sorbens and M. lucens and that the above species were able to remain active at a much higher range of humidity (66% to 90%) than in Calcutta (29% to 75%). The study further revealed that C. rufifacies required much higher temperature both in June (27°c) and September (28°c) for starting its activity than that required by (25°c)

C. megacephala, M. domestica, M. sorbens and M. lucens. C. megacephala and M. domestica required the same temperature (25°c) in June as well as in September for starting their activities; on the other hand M. sorbens and M. lucens began their activities at 25°c in June and in early September, but required a little higher temperature in late September (26°c), when the daily mean average temperature decreased considerably.

Results of the feeding activity of C. megacephala, M. domestica, M. sorbens and M. lucens studied here revealed similarity with the exprimental observation of Parker (1962) on the feeding activity of M. domestica in Sudan. All these species reported in the present study showed a clear bimodality curve in their feeding activity which is in conformity with their activities at field. Highest feeding activity was observed in the afternoon.

A double peak of mating reaction was recorded at Poona by Ilse and Mulherkar (1954) who noted that the first peak occurred between 6.30 am to 9 am and the second peak occurred between 11.30 am to 3.30 pm. Results of the present investigation in the study area are similar to the observations made by the above authors, except for the feet that morning and evening peaks of mating activity in Calliphorid and Muscid flies including M. domestica occurred much later and the evening peaks in all the cases were higher than the morning peak. Comparable observations on mating activity of

Musca domestica were also made by Parker (1962) in Sudan, who reported that low temperature delayed the morning peak of mating activity in November and December by two hours as compared to that in June to September. The delay in the occurrence of mating peaks in the study area was probably due to comparatively low temperature and high relative humidity.

The oviposition time of M. domestica nebulo at Poona, India (Deoras and Ranade, 1957) and that of M. domestica in Sudan (Parker, 1962) were found to be mainly in the early morning or in the late evening. The above observations, as far as it goes, is not incompatable with the results of the present study except in the case of M. lucens which ovipositied only in the morning (6 hrs to 9 hrs).

The emergence of M. domestica from the puparium was studied in Sudan by Parker (1962) who found that the emergence rose to a single peak during the course of the day and it occurr two hours before noon. The study reported here also reveal the occurrence of a single peak of emergence in M. domestica, C. megacephala, C. rufifacies and M. sorbens at 8,30 am but not in M. lucens whose peak of emergence occurred at 6.30 am. The occurrence of early peak of emergence in the present study area in comparison to that reported by Parker (1962) in Sudan is possibly due to the difference in climatic conditions.

Various diurnal activities studied here, although differing in degrees, are all alike in their nature and are strictly confined to hours of daylight.

SUMMARY

(1) Diurnal activity of Calliphorid and Muscid flies occur with the rise of temperature. These flies exhibit bimodal diel activity curve in June and in early September and an unimodal curve in late September in Jalpaiguri District.

(2) Activity of Calliphorid and Muscid flies are spread over the whole daylight period due to the occurrence of higher mean temperature throughout the day in the study area.

(3) Inactivity of flies during noon hours in *Chrysomya megacephala* and *Chrysomya rufifacies* is probably due to rise of ambient temperature beyond the level of thermal preferendum.

(4) Thermal preferendum of *Musca domestica* and *M. lucens* is 33°c while that of *M. sorbens* is 33.5°c in the study area.

(5) Diurnal activity in Muscids ceases either due to cross of thermal preferendum value or due to rainfall.

(6) No definite pattern emerges in case of *Hemipyrellia ligurriens* because of their very low number. Their maximum activity has been noticed at about 29°c.

(7) Sarcophagid flies show signs of activity above 25.5°c and their maximum activity occurs when temperature ranges between 29°c to 33°c.

(8) Bimodal feeding and mating activity curve occurs in *C. megacephala*, *M. domestica*, *M. sorbens* and *M. lucens*.

Maximum feeding and mating activities occur in the afternoon.

(9) Oviposition in C. megacephala, M. domestica and M. sorbens can occur either in the morning or in the afternoon. In C. rufifacies and in M. lucens the activity occurs in the morning only.

(10) Pupal emergence of C. megacephala, C. rufifacies, M. domestica and M. sorbens occur at 8.30 am while that of M. lucens occurs at 6.30 am.

FIGURES AND TABLES

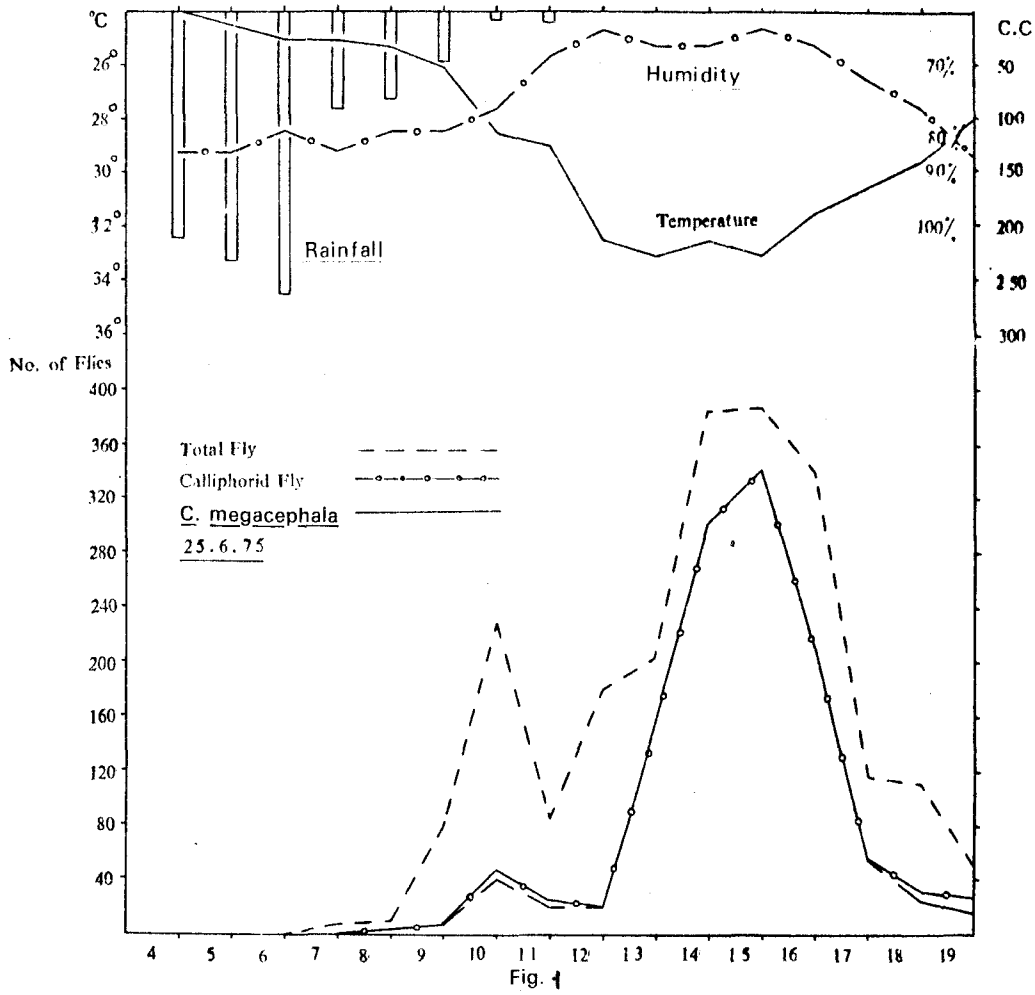
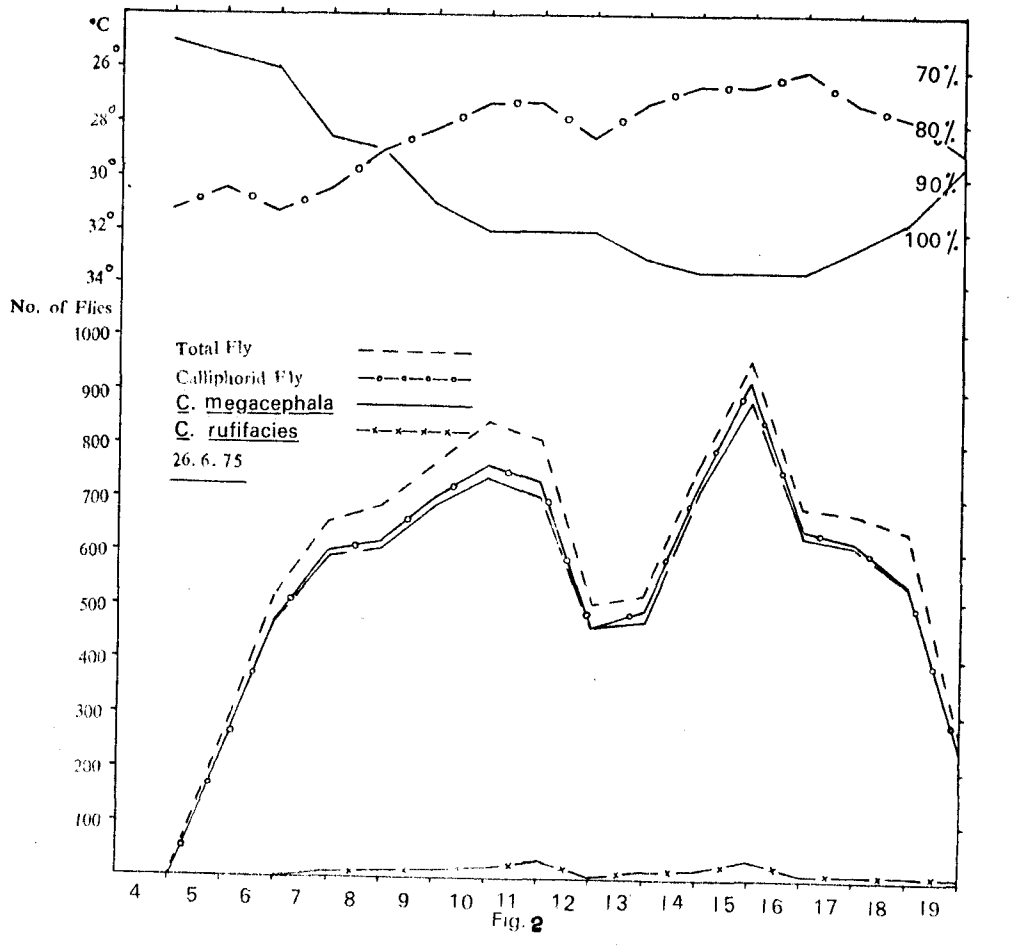

°C
C.C
Humidity
Rainfall
Temperature
70%
80%
90%
100%
No. of Flies
Total Fly
Calliphorid Fly
C. megacephala
25.6.75

Fig. 1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70%
80%
90%
100%
No. of Flies
Total Fly
Calliphorid Fly
C. megacephala
C. rufifacies
26.6.75

Fig. 2

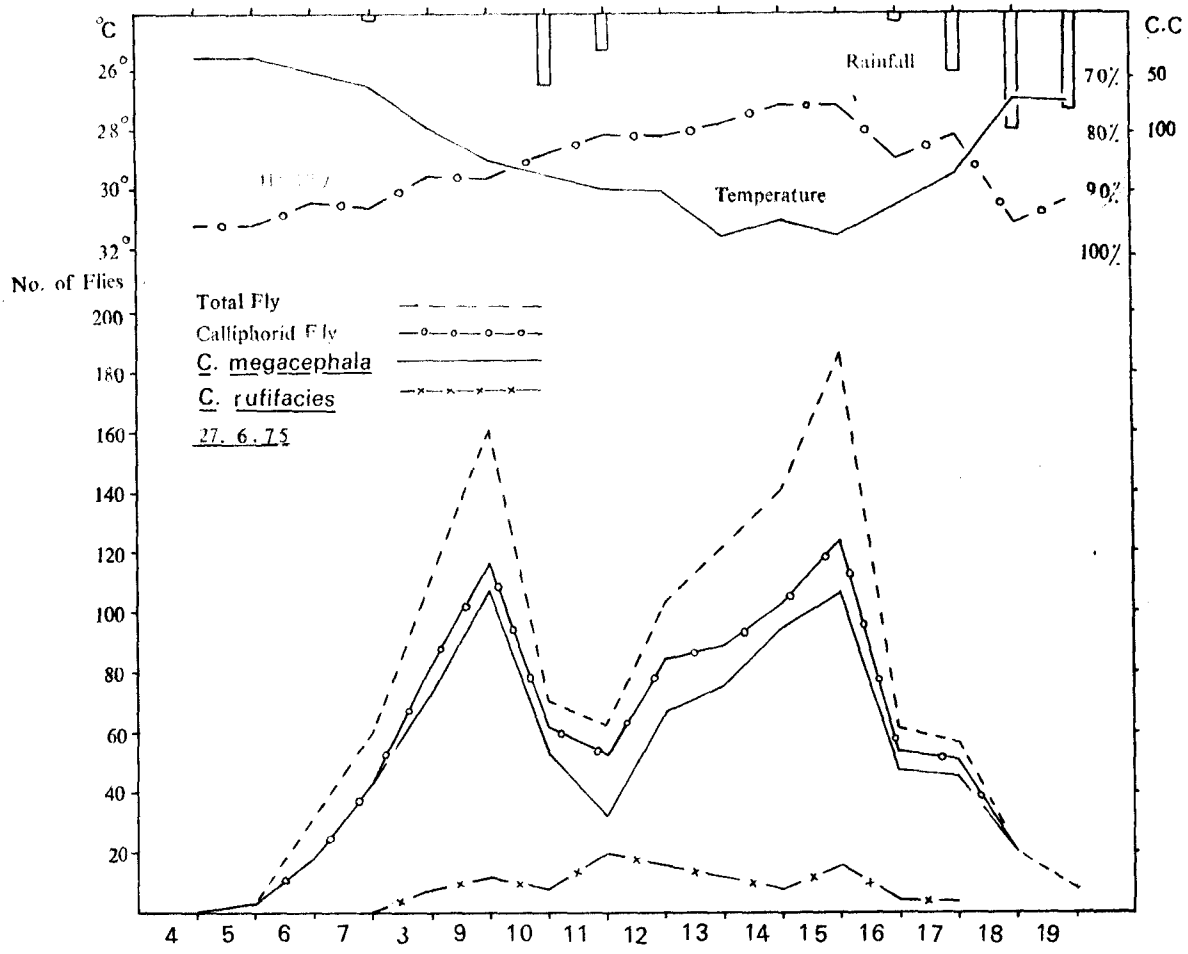
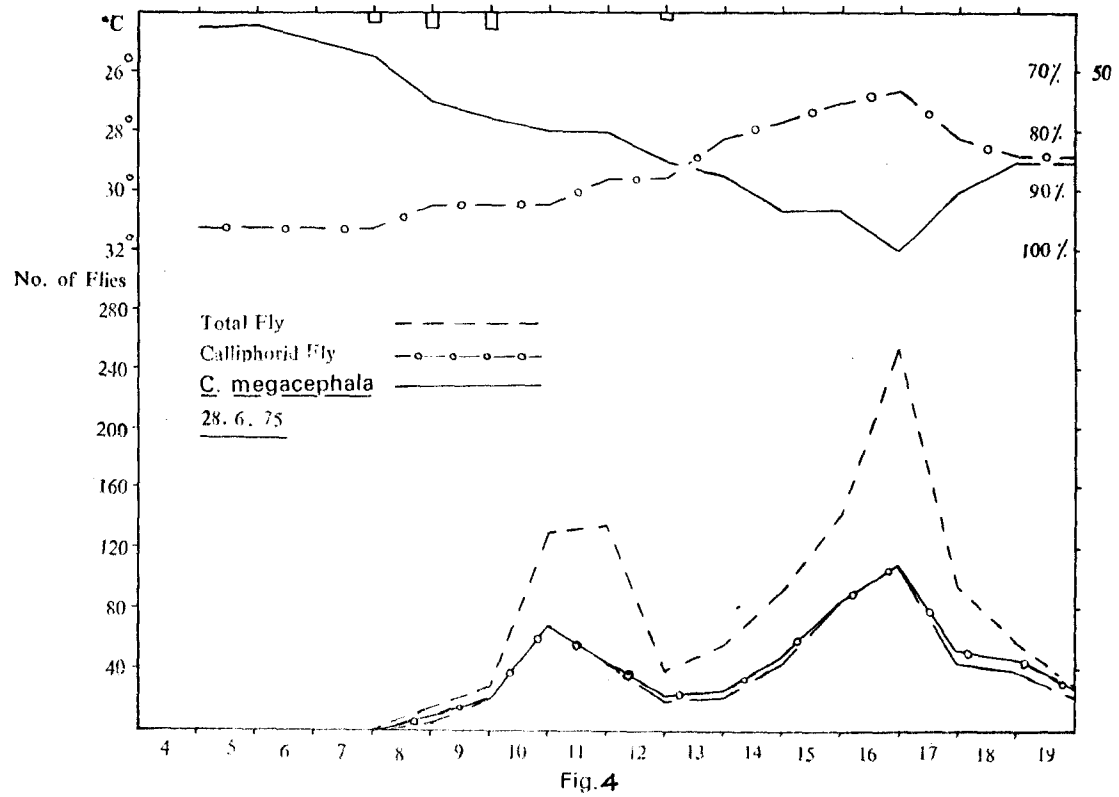

°C
C.C
Rainfall
Temperature
70%
80%
90%
100%
50
100
No. of Flies
Total Fly
Calliphorid Fly
C. megacephala
C. rufifacies
27. 6. 75

Fig. 3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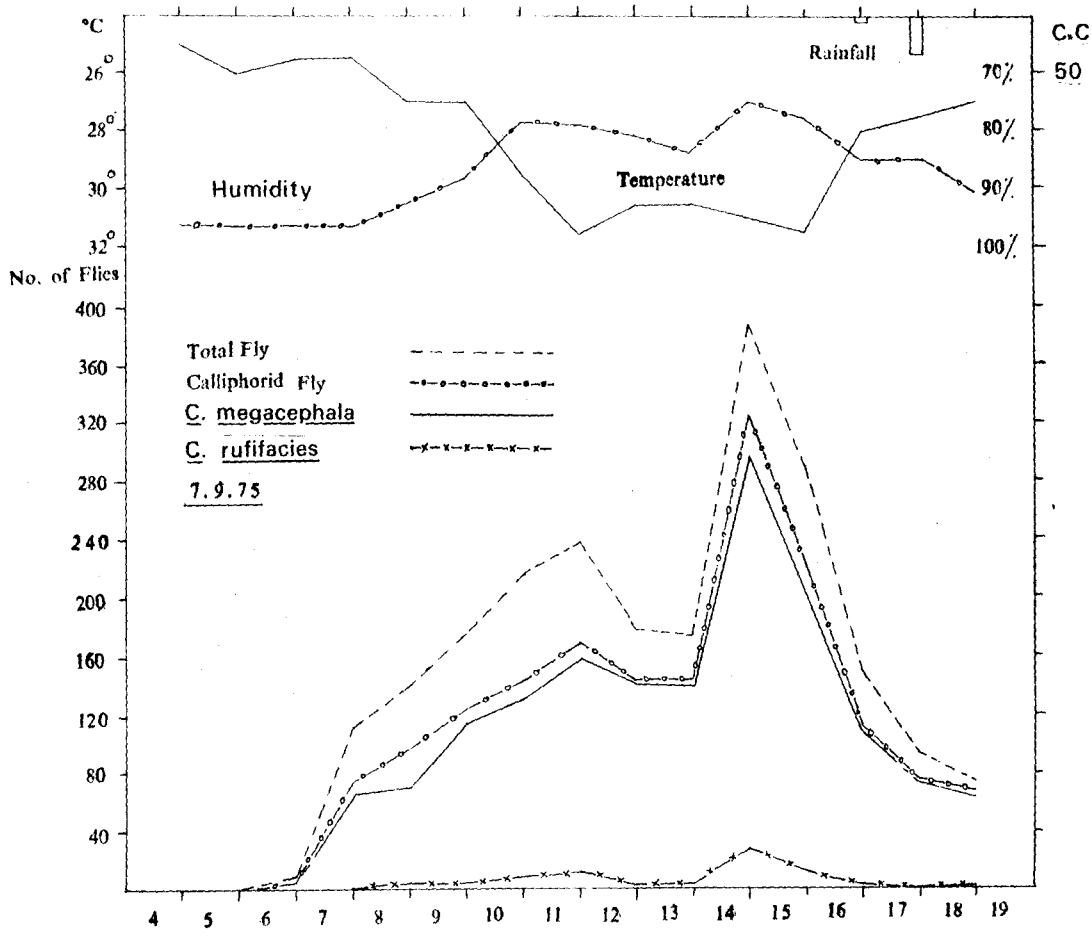
80%
90%
100 %
50
No. of Flies
Total Fly
Calliphorid Fly
C. megacephala
28. 6. 75

Fig. 4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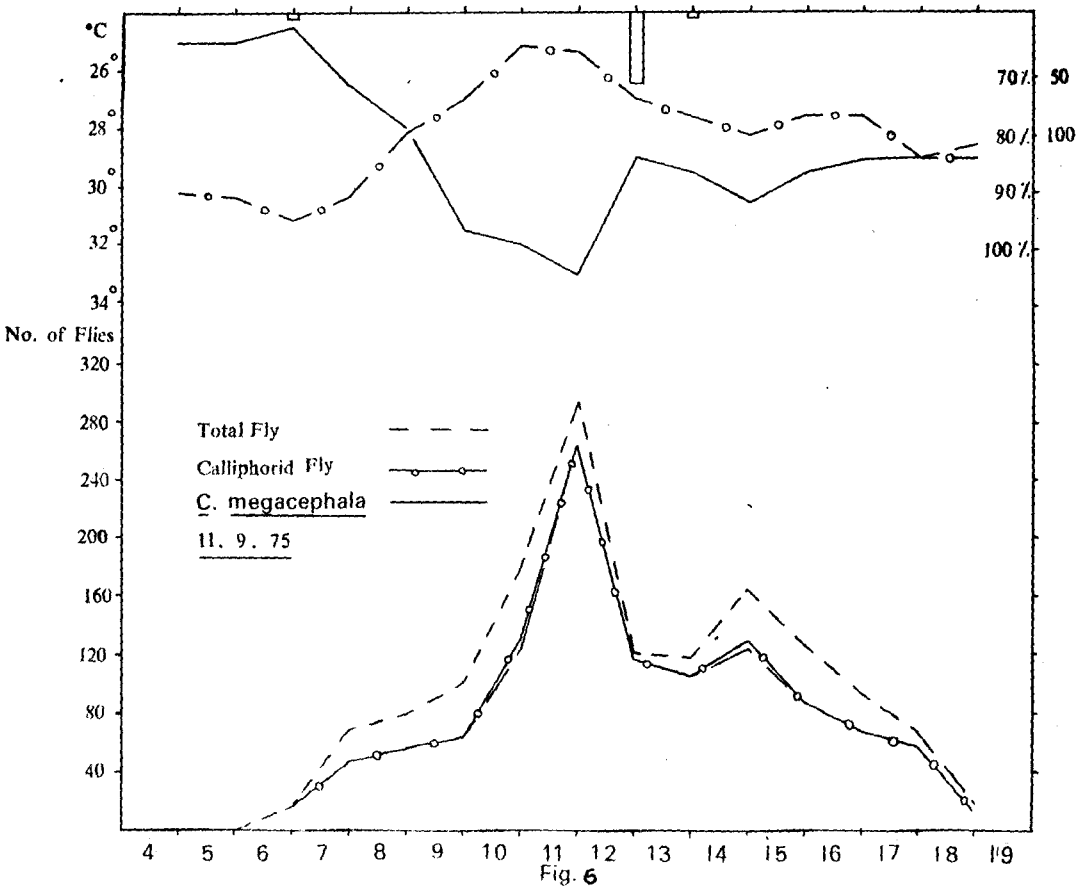
28°
30°
32°
Rainfall
C.C
50
70%
80%
90%
100%
Humidity
Temperature
No. of Flies
400
360
320
280
240
200
160
120
80
40
Total Fly
Calliphorid Fly
C. megacephala
C. rufifacies
7.9.75
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Fig. 5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No. of Flies
320
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240
200
160
120
80
40
Total Fly
Calliphorid Fly
C. megacephala
11. 9. 75
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Fig. 6

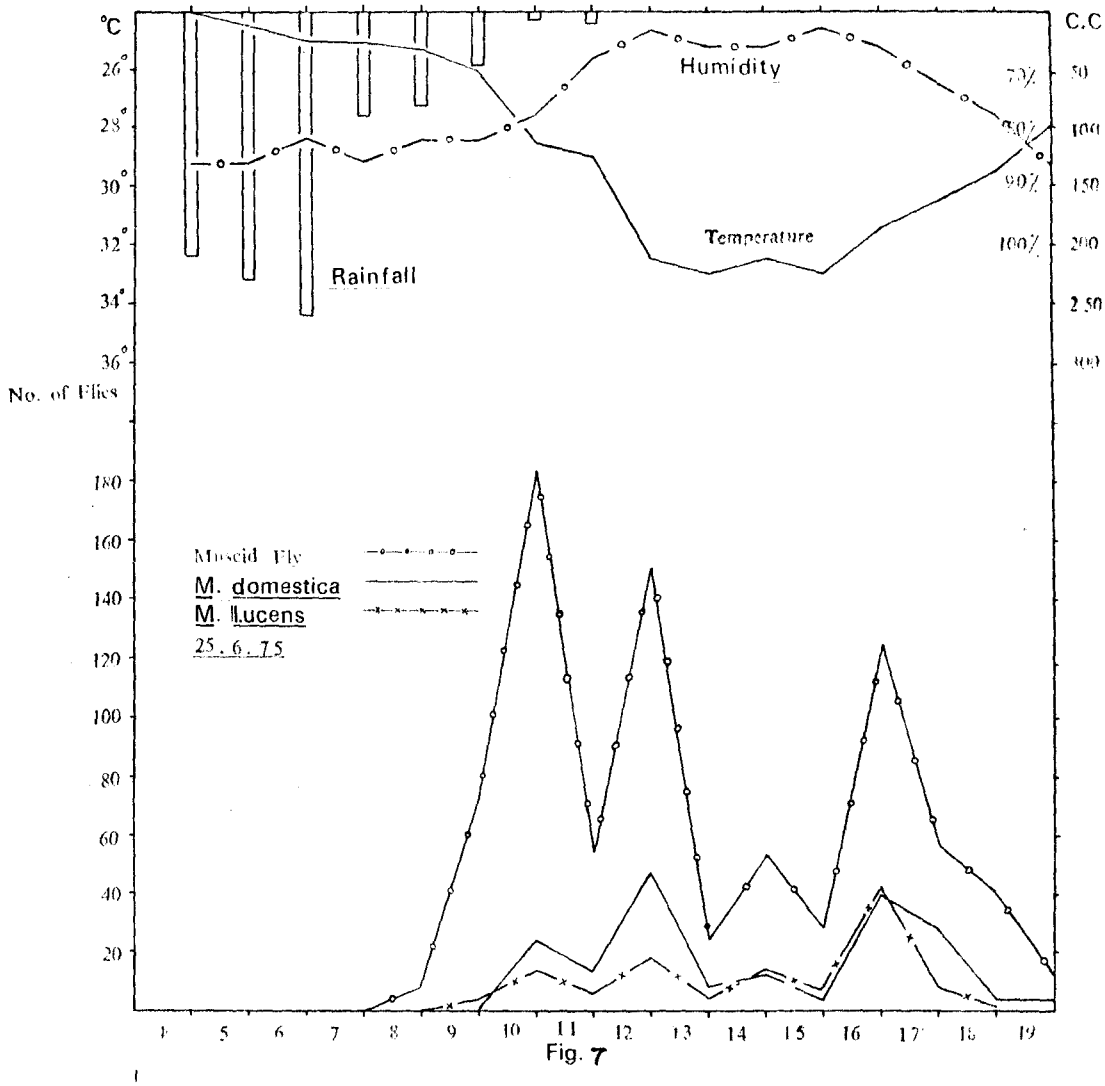

°C
C.C
Humidity
Temperature
Rainfall
No. of Flies
Muscid Fly
M. domestica
M. lucens
25.6.75

Fig. 7

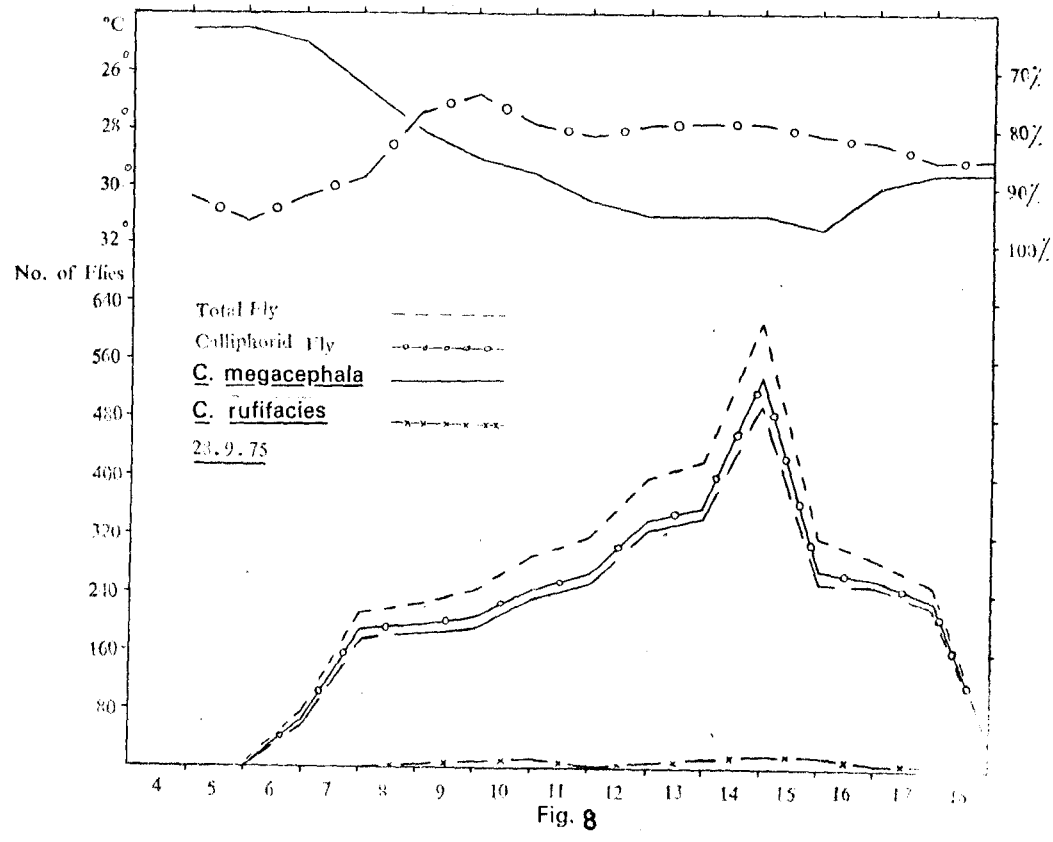
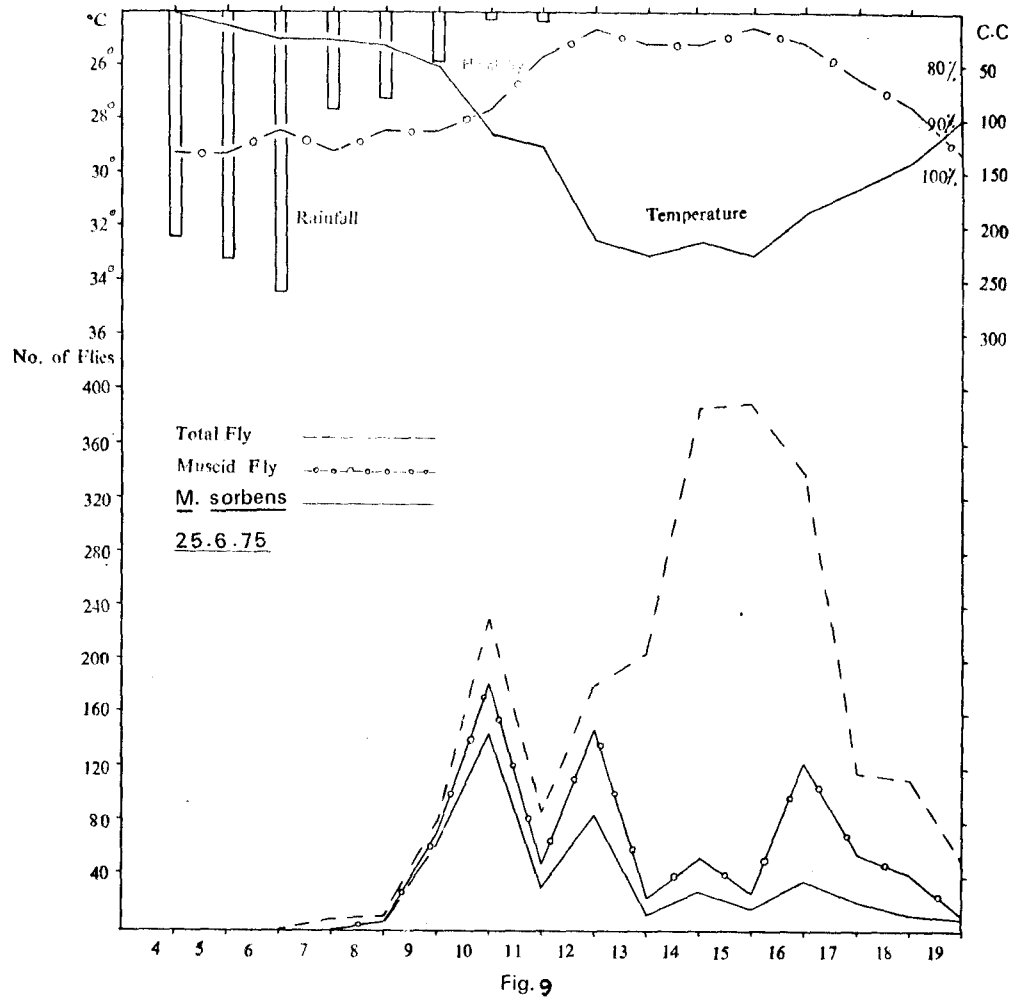

°C
No. of Flies
Total Fly
Calliphorid Fly
C. megacephala
C. rufifacies
23.9.75

Fig. 8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C.C
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30°
32°
34°
36
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90%
100%
50
100
150
200
250
300
Rainfall
Temperature
No. of Flies
400
360
320
280
240
200
160
120
80
40
Total Fly
Muscid Fly
M. sorbens
25.6.75
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

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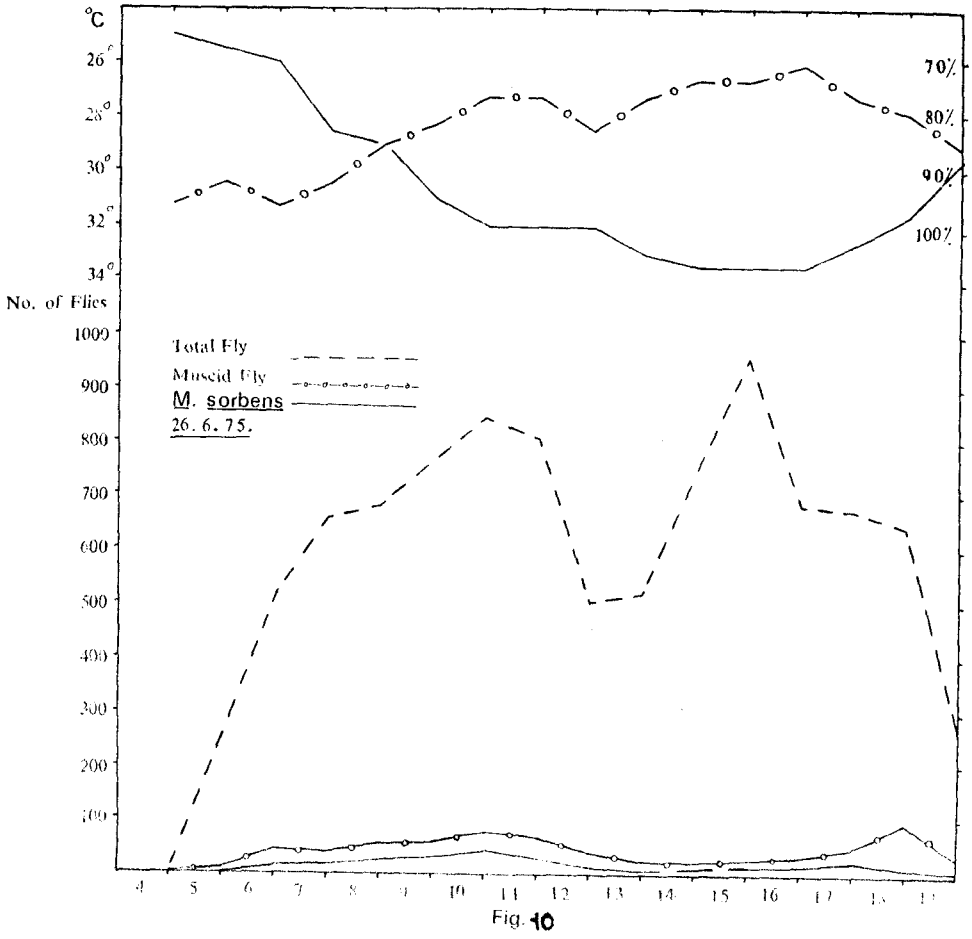
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30°
32°
34°
70%
80%
90%
100%
No. of Flies
1000
900
800
700
600
500
400
300
200
100
Total Fly
Muscid Fly
M. sorbens
26.6.75.
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Fig. 10

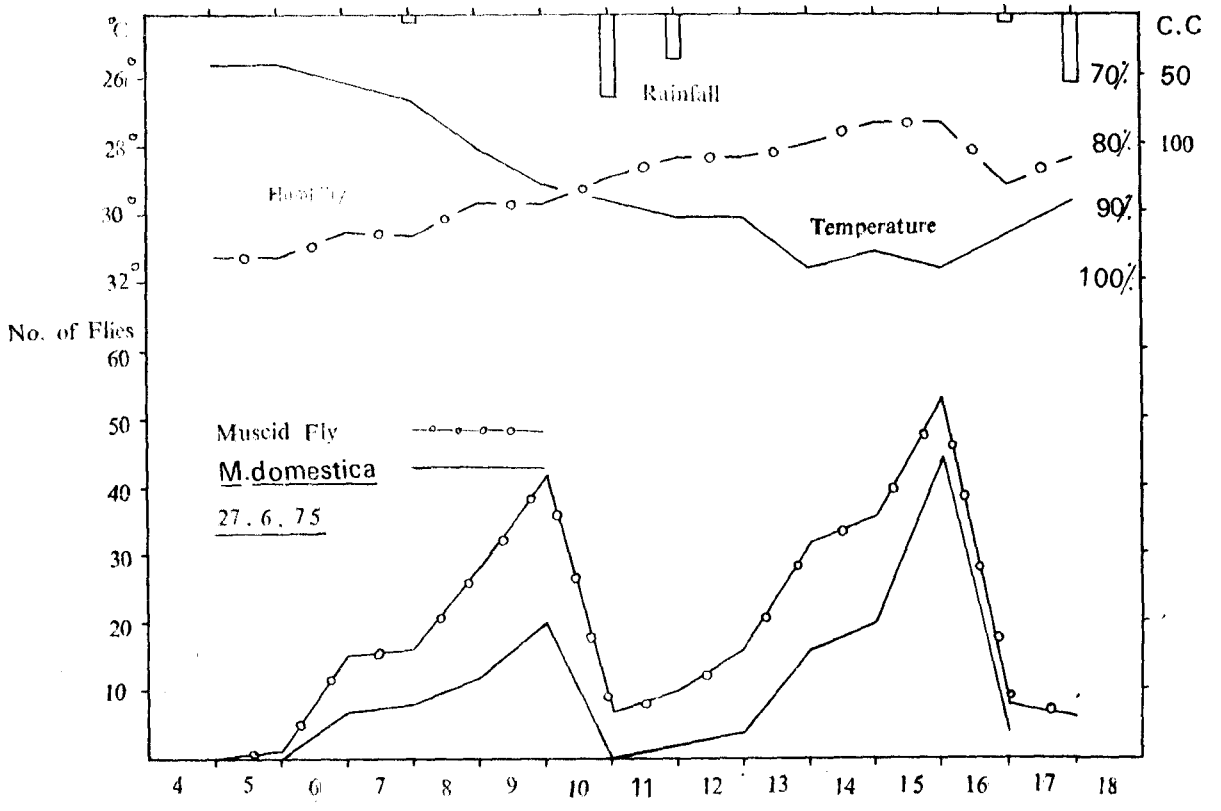
°C
C.C
Rainfall
70%
80%
90%
100%
Temperature
No. of Flies
Muscid Fly
M.domestica
27.6.75
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Fig. 11

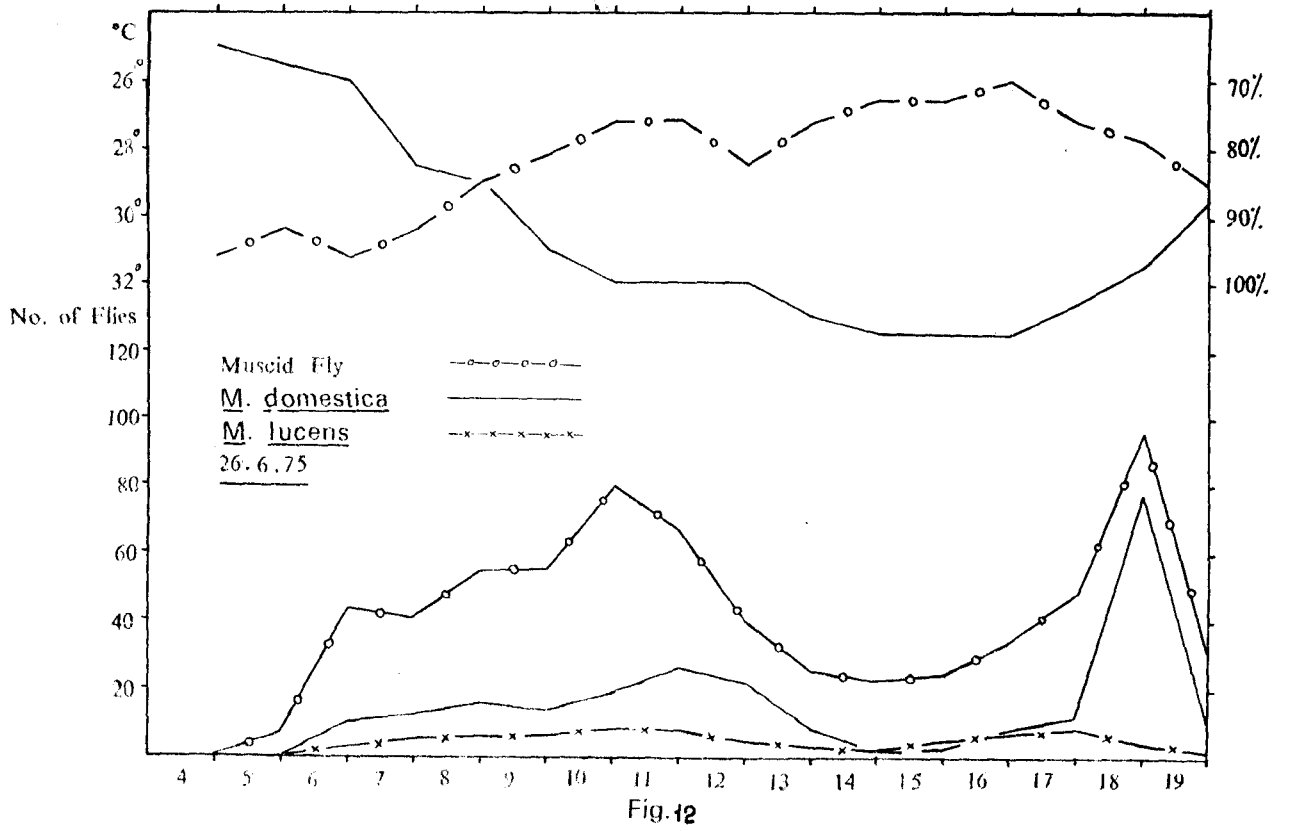
°C
70%
80%
90%
100%
No. of Flies
Muscid Fly
M. domestica
M. lucens
26.6.75
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Fig. 12

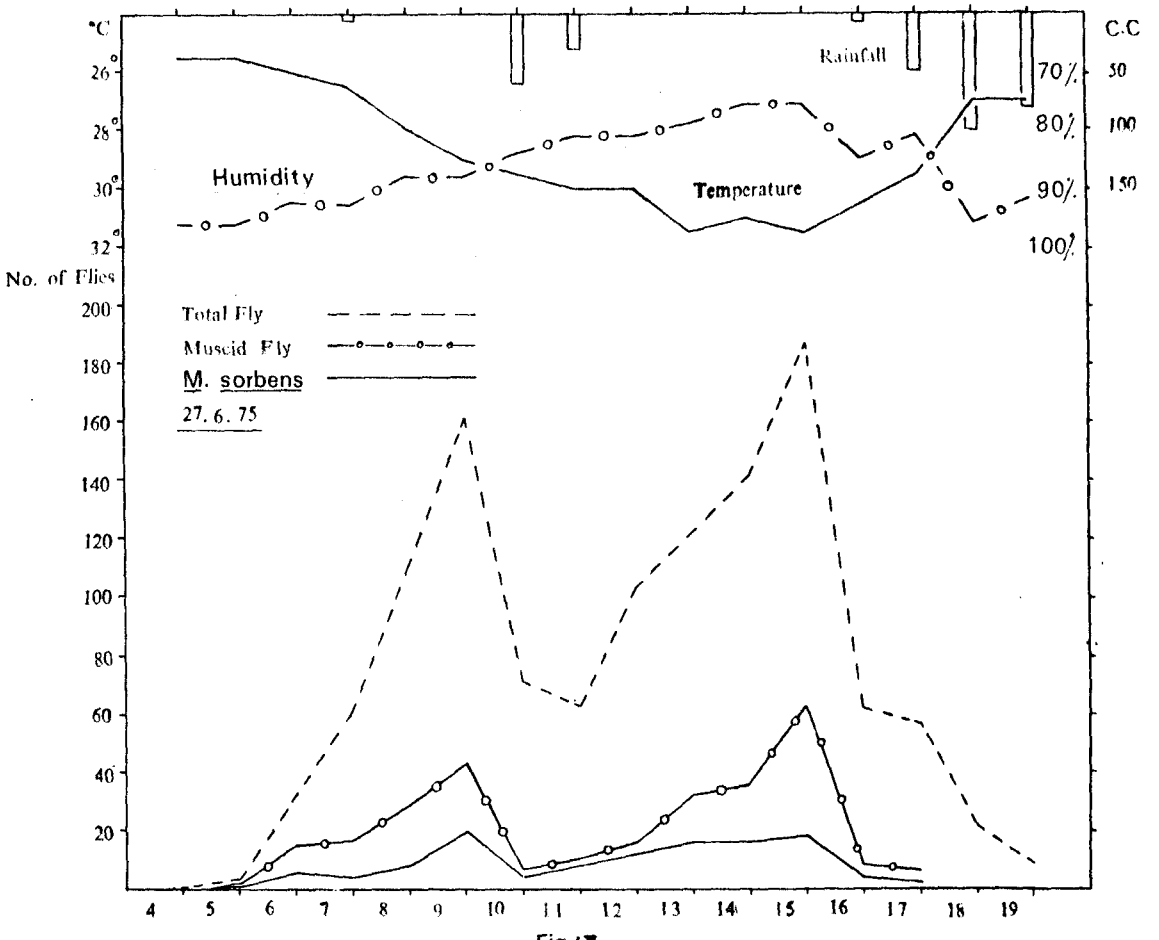
°C
26°
28°
30°
32°
C.C
Rainfall
70%
80%
90%
100%
50
100
150
Humidity
Temperature
No. of Flies
Total Fly
Muscid Fly
M. sorbens
27. 6. 75
200
180
160
140
120
100
80
60
40
20
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Fig.13

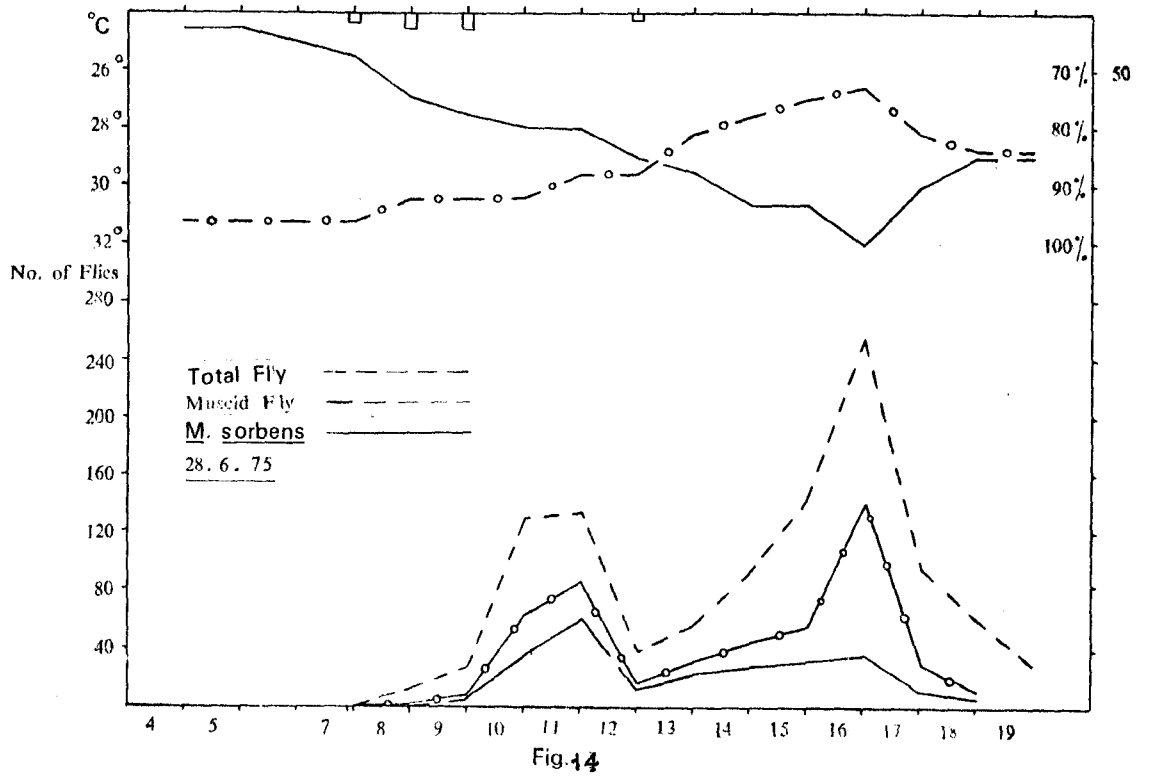
°C
26°
28°
30°
32°
70%
80%
90%
100%
50
No. of Flies
Total Fly
Muscid Fly
M. sorbens
28. 6. 75
280
240
200
160
120
80
40
4 5 7 8 9 10 11 12 13 14 15 16 17 18 19

Fig.14

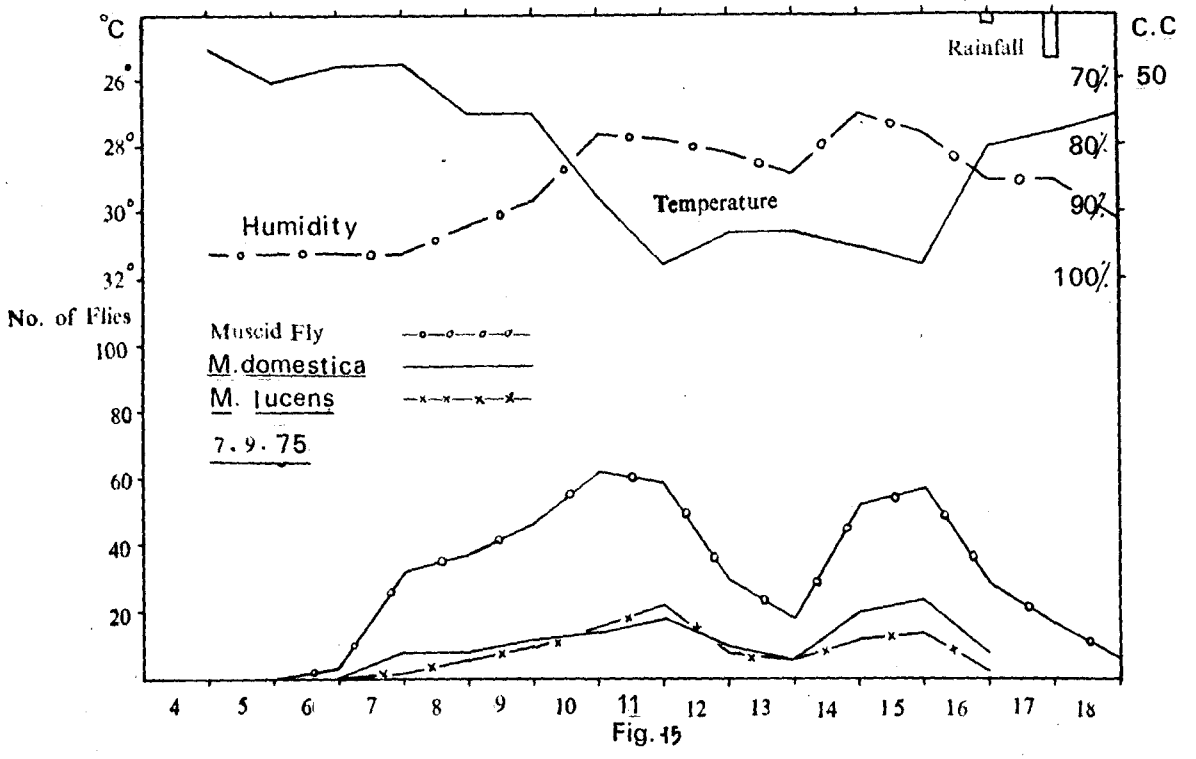
°C
C.C
Rainfall
26°
28°
30°
32°
70%
80%
90%
100%
50
Humidity
Temperature
No. of Flies
Muscid Fly
M.domestica
M. lucens
7.9.75
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Fig. 15

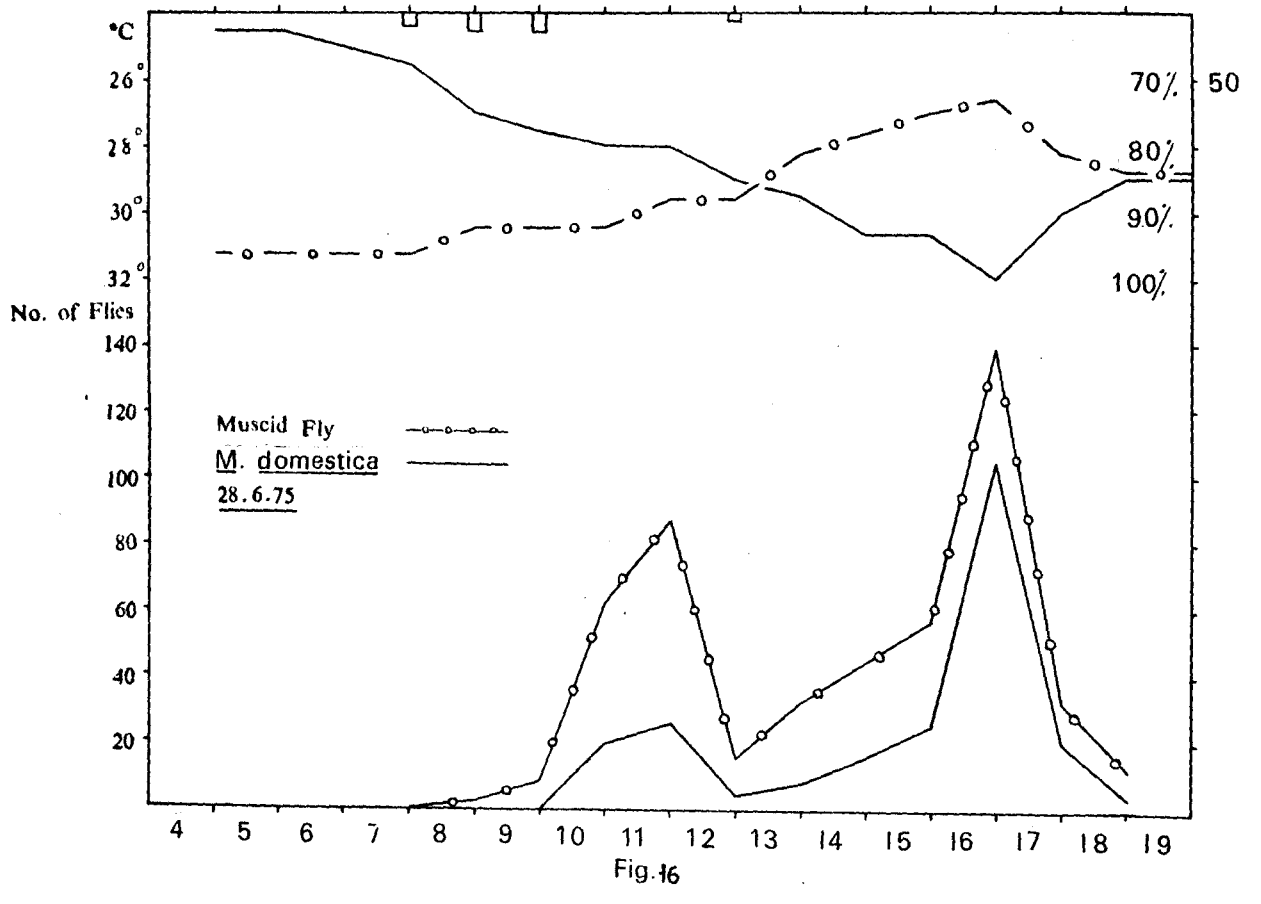
°C
26°
28°
30°
32°
70%
80%
90%
100%
50
No. of Flies
Muscid Fly
M. domestica
28.6.75
140
120
100
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Fig. 16

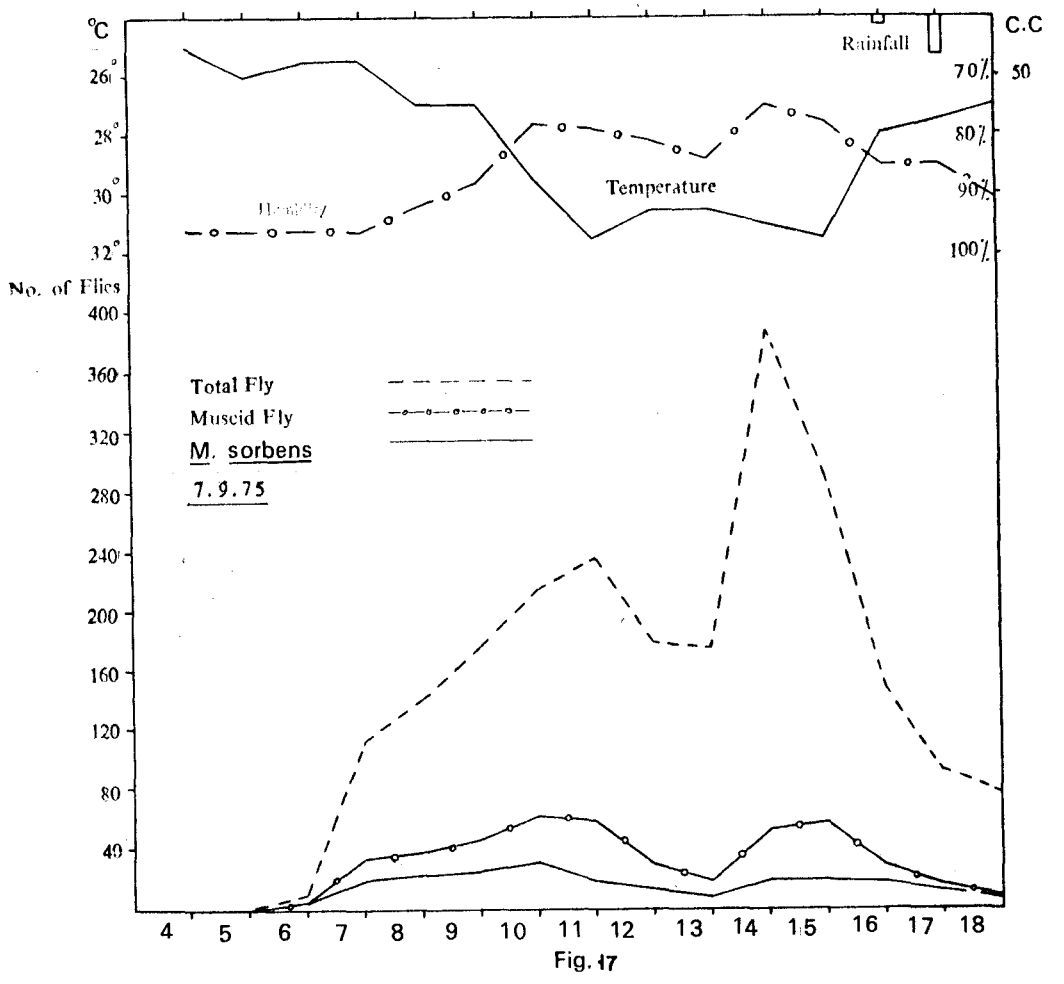
°C
C.C
Rainfall
70%
80%
90%
100%
50
Temperature
No. of Flies
Total Fly
Muscid Fly
M. sorbens
7.9.75
400
360
320
280
240
200
160
120
80
40
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Fig. 17

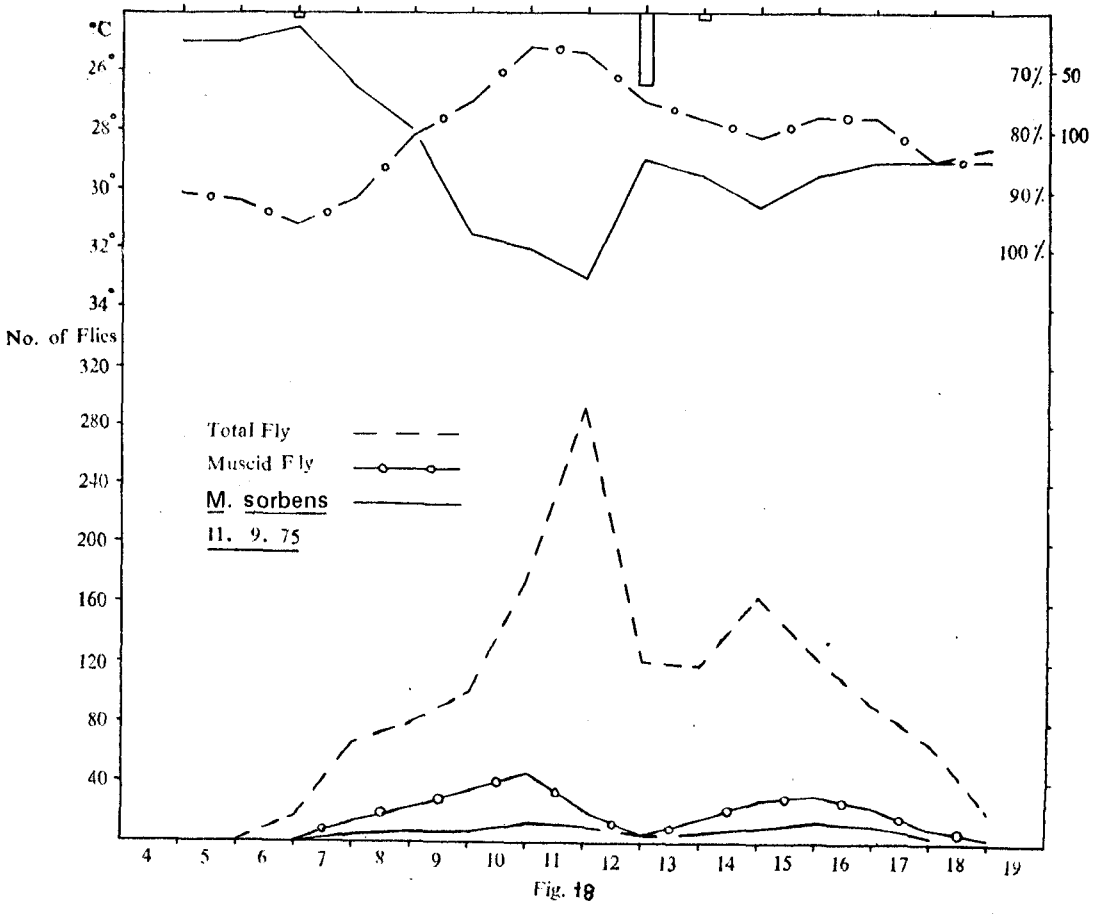
°C
70%
80%
90%
100%
50
100
No. of Flies
Total Fly
Muscid Fly
M. sorbens
11. 9. 75
320
280
240
200
160
120
80
40
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Fig. 18

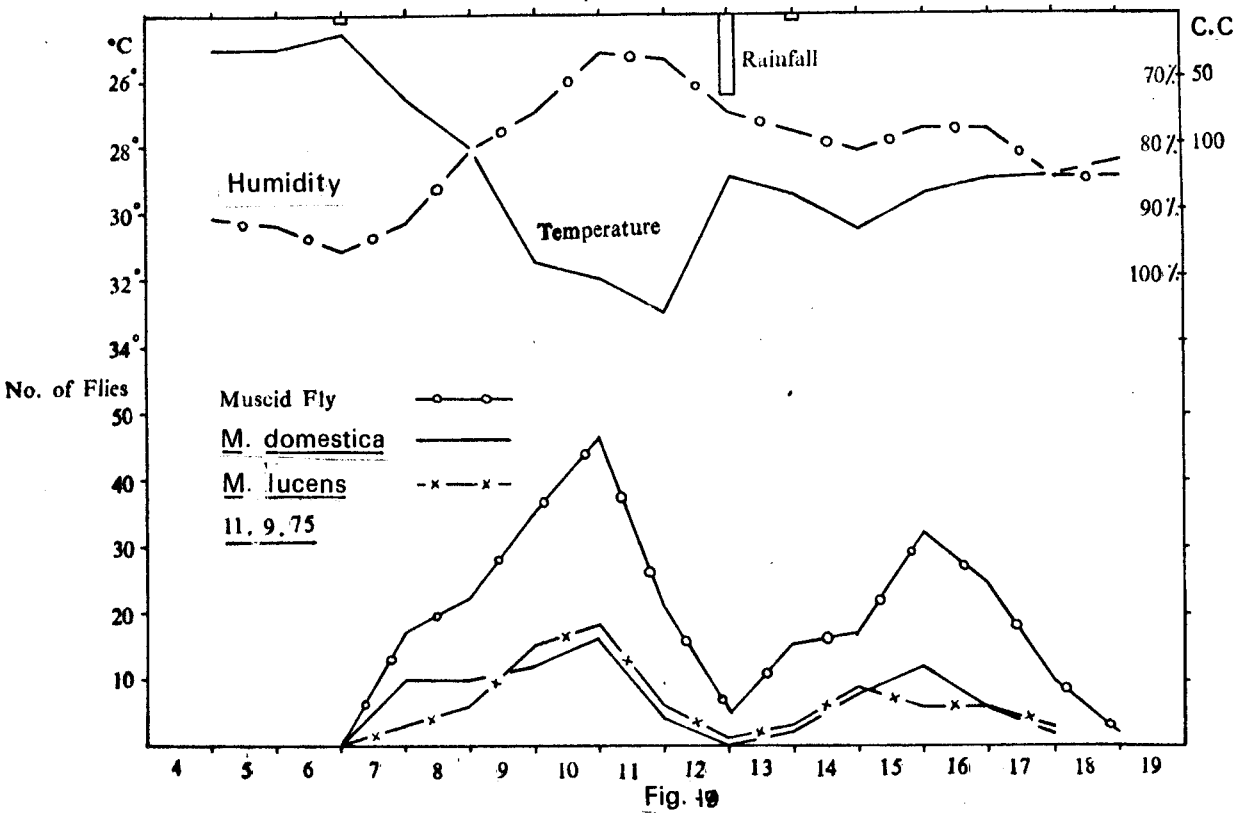
°C
26°
28°
30°
32°
34°
C.C
50
100
70%
80%
90%
100%
Rainfall
Humidity
Temperature
No. of Flies
Muscid Fly
M. domestica
M. lucens
11. 9. 75
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Fig. 19

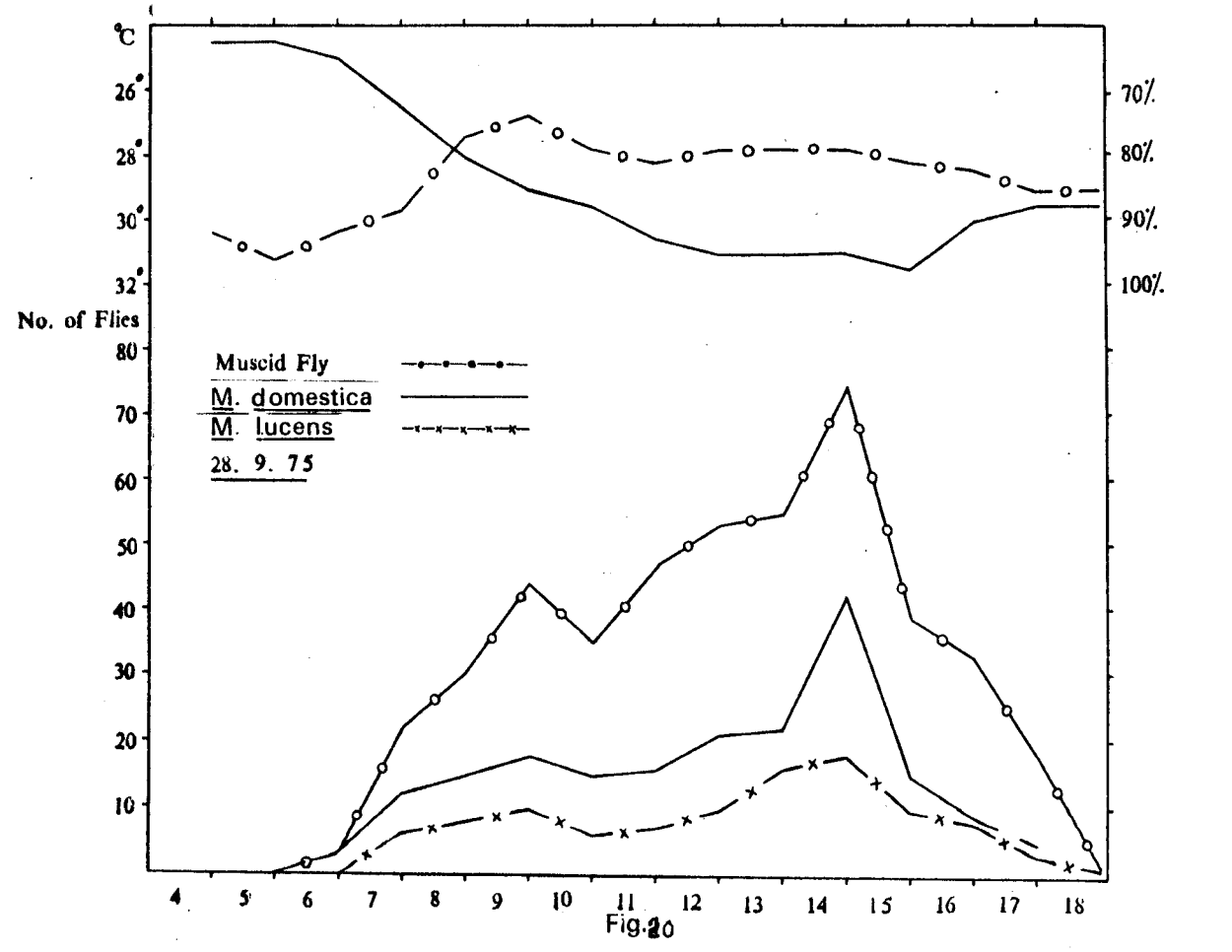
°C
26°
28°
30°
32°
70%
80%
90%
100%
No. of Flies
Muscid Fly
M. domestica
M. lucens
28. 9. 75
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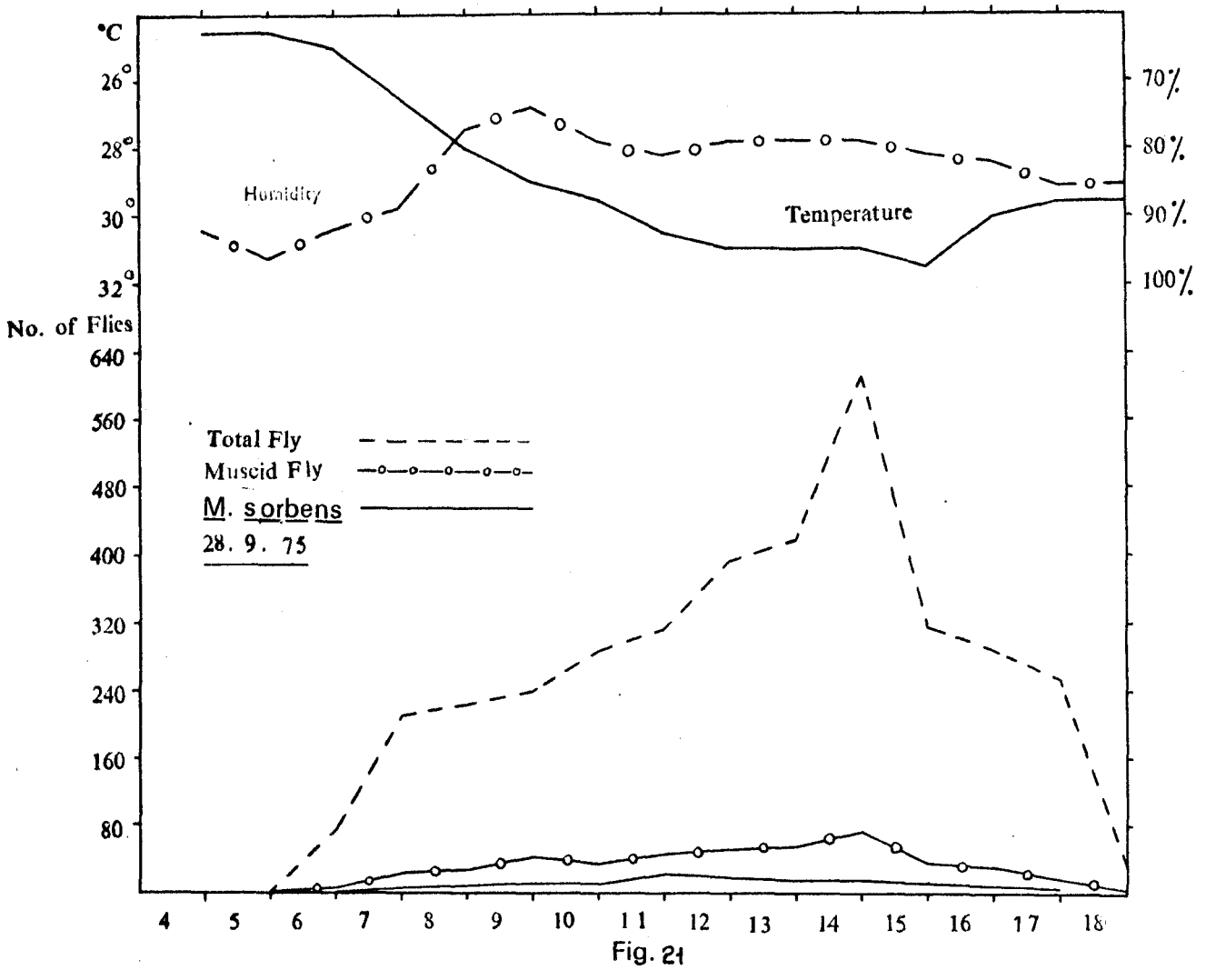
Fig. 20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30°
32°
70%
80%
90%
100%
Humidity
Temperature
No. of Flies
640
560
480
400
320
240
160
80
Total Fly
Muscid Fly
M. sorbens
28. 9. 75
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Fig. 21

Table No. 1 : Hourly Catch of Flies for the Study of Diurnal activity on 25.6.75 in Jalpaiguri Town with Fish-baited traps.

Sl No.	Species	Sex	Hours of experiment															TOTAL
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	
1.	Chrysomya megacephala	Female				1	2	7	39	16	19	118	253	290	165	48	22	16	996
		Male						1	1	4	1	36	45	50	37	2	2	1	180
		Total				1	2	8	40	20	20	154	298	340	202	50	34	17	1176
2.	Hemipyrellia ligurriens	Female				3			6	3						3	6	12	33
		Male								3							3	3	9
		Total				3			6	6						3	9	15	42
3.	Other Calliphorids	Female							1				4	1	8	1			15
		Male													3				3
		Total							1				4	1	11	1			18
4.	Calliphorid	Total				4	2	8	47	26	80	154	302	341	213	54	33	32	1256
5.	Musca domestica	Female							20	14	44	6	12	4	34	21	18	4	177
		Male							4		4	2			6	7	2		25
		Total							24	14	48	8	12	4	40	28	20	4	202
6.	Musca sorbens	Female					8	56	120	32	64	12	24	8	32	18	10	7	391
		Male						8	24		20		4	8	4	3	1	2	74
		Total					8	64	144	32	84	12	28	16	36	21	11	9	465
7.	Musca lucens	Female						4	14	4	8	3	12	8	32	6	2		93
		Male								2	10	2	2		10	2			28
		Total						4	14	6	18	5	14	8	42	8	2		121
8.	Other Muscids	Female						4		2					6		8		20
		Male							1	1									2
		Total						4	1	3					6		8		22
9.	Muscid	Total					8	72	183	55	150	25	54	28	124	57	41	13	810
10.	*Sarcophagids	Female				3				3	3	12	9	15	3		33	6	87
		Male									6	12	21	3		6	6		54
		Total				3				3	9	24	30	18	3	6	39	6	141
11.	Total Flies					7	10	80	230	84	179	203	386	387	340	117	113	51	2187
12	Hourly mean temp. °C		24	24.5	23	25	25.5	26	28.5	29	32.5	33	32.5	33	31.5	30.5	29.5	28	
	Hourly relative humidity %		96	96	92	96	92	92	88	78	73	76	76	73	76	82	88	96	
	Visibility		0.8	1.6	4.2	13	37	100	200	250	350	300	200	300	200	100	25	0.8	
	Rain Fall		P	P	P	P	P	P		P									

*The number of different Sarcophagid flies are so insignificant that they are not considered here.

P denotes presence of rainfall.

Table No. 2 : Hourly Catch of Flies For the Study of Diurnal a[illegible] traps.

Sl. No.	Species	Sex	Hours of experiment 5-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	Total
1.	Chrysomya megacephala	Female	215	454	568	575	688	688	675	436	469	687	819	515	538	418	169	7884
		Male	23	18	24	32	29	51	25	23	6	22	67	118	70	121	65	694
		Total	238	472	592	607	687	739	700	459	475	709	886	633	608	539	234	8578
2.	Chrysomya ruffifacies	Female			4	11	9	11	19	2	8	7	18	4	5	4	1	103
		Male			1	1	4	10	12	1	6	8	16	4	3	1	2	69
		Total			5	12	13	21	31	3	14	15	34	8	8	5	3	172
3.	Other Calliphorids	Female			2			1			1		1	2	1			8
		Male			1													
		Total			3			1			1		1	2	1			9
4.	Calliphorid	Total	238	472	600	619	700	761	731	462	490	724	921	643	617	544	237	8759
5.	Musca domestica	Female	1	10	11	12	13	19	26	21	9	2	2	6	10	64	11	217
		Male		1	2	4	1		1	1			1	2	3	14		30
		Total	1	11	13	16	14	19	27	22	9	2	3	8	13	78	11	247
6.	Musca sorbens	Female	5	13	17	25	27	43	28	10	7	12	13	17	24	6	6	253
		Male		2	1	3	5	3	2	1	2	1	2		1	5	3	31
		Total	5	15	18	28	32	46	30	11	9	13	15	17	25	11	9	284
7.	Musca lucens	Female		2	3	4	4	7	7	4	3	1	3	6	6	2	2	54
		Male		1	2	2	3	2	1	1		1	2	1	3	2		21
		Total		3	5	6	7	9	8	5	3	2	5	7	9	4	2	75
8.	Other Muscids	Female	1	13	5	4	2	4	5	2	5	6	2	2	2	2	7	62
		Male		1				1									2	4
		Total	1	14	5	4	2	5	5	2	5	6	2	2	2	2	9	66
9.	Muscid	Total	7	43	41	54	55	79	70	40	26	23	25	34	49	95	31	672
10.	*Sarcophagids	Female			10	4	6		4			2	4	6	8	4		38
		Male		2	4	8	4	4	4	2	6	6	4	2				46
		Total		2	14	12	10	4	8	2	6	8	8	8	8	4		94
11.	Total Flies		245	517	655	805	785	844	809	504	522	755	954	685	674	645	268	9525
	Hourly mean temp. °C	25	25.5	26	28.5	29	31	32	32	32	33	33.5	33.5	33.5	32.5	31.5	29.5	
	Hourly relative humidity %	96	92	96	92	85	81	76	76	82	76	73	73	70	76	79	85	
	Visibility	0.08	13	87	200	200	300	250	175	400	350	350	250	350	200	100	0.9	

*The number of different Sarcophagid flies are so insignificant that they are not considered here.

Table No. 5 : Hourly Catch of Flies for the Study of Diurnal activity on 27.6.75 in Jalpaiguri Town with fish-baited traps.

Sl. No.	Species	Sex	Hours of experiment															TOTAL
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	
1.	Chrysomya megacephala	Female		2	17	44	64	96	52	31	63	65	93	105	45	41	18	9	745
		Male					10	11	2	1	4	11	2	1	3	6	3		54
		Total		2	17	44	74	107	54	32	67	76	95	106	48	47	21	9	799
2.	Chrysomya rufifacies	Female					8	8	4	12	16	8	8	8	4	4			80
		Male						4	4	8		4		8					28
		Total					8	12	8	20	16	12	8	16	4	4			108
3.	Other Calliphorids	Female								1	1	1		2	1				6
		Male									1				1				2
		Total								1	2	1		2	2				8
4.	Calliphorid	Total		2	17	44	82	119	62	53	85	89	103	124	54	51	21	9	915
5.	Musca domestica	Female			6	8	12	20		2	4	12	16	39	4				123
		Male			1							4	4	5					14
		Total			7	8	12	20		2	4	16	20	44	4				137
6.	Musca sorbens	Female			6	4	4	16	4	7	8	4	13	16	4	2			88
		Male					4	4		1	4	12	3	2					30
		Total			6	4	8	20	4	8	12	16	16	18	4	2			118
7.	Other Muscids	Female		1	2	4	6	2	3					1		4			23
		Male					2												2
		Total		1	2	4	8	2	3					1		4			25
8.	Muscid	Total		1	15	16	28	42	7	10	16	32	36	63	8	6			280
9.	*Sarcophagids	Female				6	6	2	8	4	4	10	8	8	4		2		62
		Male						2	2	4		2	2	4	2				18
		Total				6	6	4	10	8	4	12	10	12	6		2		80
10.	Total Flies			3	32	60	110	161	71	63	103	122	141	187	62	57	21	9	1202
	Hourly mean temp. °C		25.5	25.5	26	26.5	28	29	29.5	30	30	31.5	31	31.5	30.5	29.5	27	27	
	Hourly relative humidity %		96	96	92	92	88	88	84	81	81	79	76	76	85	81	96	92	
	Visibility		0.8	5.2	16	75	185	150	75	200	225	350	350	200	130	85	15	1.9	
	Rain fall					P			P	P					P	P	P	P	

*The number of different Sarcophagid flies are so insignificant that they were not considered here.

P denotes presence of rainfall.

Table No. 4 : Hourly Catch of Flies for the Study of Diurnal activity on 28.6.75 in Jalpaiguri Town with Jackfruit (ripe) baited traps.

Sl. No.	Species.	Sex.	Hours of experiment.															TOTAL
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	
1.	Chrysomya megacephala	Female					4	8	44	28	16	16	32	76	84	24	28	16	376
		Male						12	24	18	4	8	12	8	24	20	12	8	150
		Total					4	20	68	46	20	24	44	84	108	44	40	28	526
2.	Hemipyrellia ligurriens	Female					3									3	6	3	15
		Male					3				3		3			3	3	3	18
		Total					6				3		3			6	9	6	33
3.	Other Calliphorids	Female													2				2
		Male														1			1
		Total													2	1			3
4.	Calliphorid	Total					10	20	68	46	23	24	47	84	110	51	49	30	562
5.	Musca domestica	Female							20	18	4	6	13	16	84	14	4		179
		Male								8		2	3	9	20	6			48
		Total							20	26	4	8	16	25	104	20	4		227
6.	Musca sorbens	Female						4	29	28	4	20	12	12	28	4	2		143
		Male						4	7	32	8	4	16	20	8	8	6		113
		Total						8	36	60	12	24	28	32	36	12	8		256
7.	Other Muscids	Female					2		6										8
		Male																	0
		Total					2		6										8
8.	Muscid	Total					2	8	62	86	16	32	44	57	140	32	12		491
9.	Total Flies						15	28	130	132	39	57	93	142	254	95	61	30	1064
	Hourly mean temp. °C		24.5	24.5	25	25.5	27	27.5	28	28	29	29.5	30.5	30.5	32	30	29	29	
	Hourly relative humidity %		96	96	96	96	92	92	92	88	88	81	78	75	75	81	84	84	
	Visibility		1.9	4.5	37	75	125	225	225	125	300	350	325	175	300	90	19	1.5	
	Rain fall					P	P	P			P								

P denotes presence of rainfall.

Table No. 5: Hourly Catch of Flies for the Study of Diurnal activity on 7-9-75 in Jalpaiguri Town with Fish-baited traps.

Sl. No.	Species.	Sex.	Hours of experiment														TOTAL
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	
1.	Chrysomya megacephala	Female			5	58	61	95	99	149	130	114	253	180	88	50	43	1325
		Male			1	8	10	20	32	9	11	26	43	29	21	25	21	256
		Total			6	66	71	115	131	158	141	140	296	209	109	75	64	1581
2.	Chrysomya rufifacies	Female							8	12	1	4	20	8	4	1	4	62
		Male					4	4			2		8	4				22
		Total					4	4	8	12	3	4	28	12	4	1	4	84
3.	Hemipyrellia ligurriens	Female				8	20	4	4				2					38
		Male					2	2										4
		Total				8	22	6	4				2					42
4.	Other Calliphorids	Female													1			1
		Male																0
		Total													1			1
5.	Calliphorid	Total			6	74	97	125	143	170	144	144	326	221	114	76	68	1708
6.	Musca domestica	Female				6	8	12	10	18	6	4	18	20	6			108
		Male				2			4		4	2	2	4	2			20
		Total				8	8	12	14	18	10	6	20	24	8			128
7.	Musca sorbens	Female			2	14	17	16	24	14	9	4	14	12	16	12	4	158
		Male			1	5	5	7	6	3	3	3	4	6	1	3	2	49
		Total			3	19	22	23	30	17	12	7	16	18	17	15	6	207
8.	Musca lucens	Female				2	6	8	12	16	7	6	12	8	3			80
		Male						2	4	6	1			6				19
		Total				2	6	10	16	22	8	6	12	14	3			99
9.	Other Muscids	Female				3	1	1	1	2			2	1	1	2	1	15
		Male							1									1
		Total				3	1	1	2	2			2	1	1	2	1	16
10.	Muscid	Total			13	52	57	46	62	59	30	19	52	57	29	17	7	450
11.	*Sarcophagids	Female				6	6	2	8	4	4	10	8	8	4		2	62
		Male						2	2	4		2	2	4	2			18
		Total				6	6	4	10	8	4	12	10	12	6		2	80
12.	Total Flies				9	112	140	175	215	237	178	175	388	290	149	93	77	2238
	Hourly mean temp. °C		25	26	25.5	25.5	27	27	29.5	31.5	30.5	30.5	31	31.5	28	27.5	27	
	Hourly relative humidity %		96	96	96	96	92	88	78	79	81	84	75	78	85	85	91	
	Visibility		1.8	0.8-1.6	25	75	125	175	200	300	400	175-300	225	375-400	50-75	50	0.8	
	Rain fall														P	P		

*The number of different Sarcophagid flies are so insignificant that they were not considered here.

P denotes presence of rainfall.

Table No. 6: Hourly Catch of Flies for the Study of Diurnal activity on 11.9.75 in Jalpaiguri Town with Fish baited traps.

Sl. No.	Species.	Sex.	Hours of experiment														TOTAL
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	
1.	Chrysomya megacephala	Female			12	44	56	64	116	208	116	100	108	88	68	52	16	1048
		Male			4	4			12	56		4	20			4		104
		Total			16	48	56	64	128	264	116	104	128	88	68	56	16	1152
2.	Other Calliphorids	Female							1				1					2
		Male																0
		Total							1				1					2
3.	Calliphorid	Total			16	48	56	64	129	264	116	104	129	88	68	56	16	1154
4.	Musca domestica	Female				8	7	12	10	4		2	8	12	6	2	2	73
		Male				2	3		6									11
		Total				10	10	12	16	4		2	8	12	6	2	2	84
5.	Musca sorbens	Female				4	2	6	10	8	4	4	7	11	12	4		72
		Male					4		2	2		2	3	3				16
		Total				4	6	6	12	10	4	6	10	14	12	4		88
6.	Musca lucens	Female				3	6	9	12	6	1	3	6	6	5	3		60
		Male						6	6				3		1			16
		Total				3	6	15	18	6	1	3	9	6	6	3		76
7.	Other Muscids	Female						2		1		4				1		8
		Male																0
		Total						2		1		4				1		8
8.	Muscid	Total				17	22	35	46	21	5	15	27	32	24	10	2	256
9.	*Sarcophagids	Female				2	2			4			8	6			2	24
		Male						2	2	2								6
		Total				2	2	2	2	6			8	6			2	30
10.	Total Flies				16	67	80	101	177	291	121	119	164	126	92	66	20	1440
	Hourly mean temp. °C		25	25	24.5	25.5	28	30.5	32	33	29	29.5	30.5	29.5	29	29	28.5	
	Hourly relative humidity %		91	92	96	92	81	75	66	67	95	78	81	78	78	85	85	
	Visibility		1.8	1.6	65	150	200	250	225	275	100	175	250	175	125	60	0.8-1.6	
	Rain fall				P						P	P						

*The number of different Sarcophagid flies are so insignificant that they were not considered here.

P denotes presenceof rainfall.

Table No. 7 : Hourly Catch of Flies for the Study of Diurnal activity on 28-9-75 in Jalpaiguri Town with Fish-baited traps.

Sl. No.	Species.	Sex.	Hours of experiment														TOTAL
			3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	
1.	Chrysomya megacephala	Female			58	159	174	178	224	248	324	335	495	247	214	196	30	2882
		Male				19	11	9	10	7	3	12	23	10	36	30	1	171
		Total			58	178	185	187	234	255	327	347	518	257	250	226	31	3053
2.	Chrysomya rufifacies	Female					4	8	8	4	6	8	16	12	4	4		74
		Male							2		3	4		4				13
		Total					4	8	10	4	9	12	16	16	4	4		87
3.	Hemipyrellia ligurriens	Female			9	6												15
		Male			3					3								6
		Total			12	6				3								21
4.	Other Calliphorids	Female								2	2							4
		Male								3	1							4
		Total								5	3							8
5.	Calliphorid	Total			70	184	189	195	244	267	339	359	534	273	254	230	31	3169
6.	Musca domestica	Female			3	12	12	15	12	15	17	18	36	9	6	4		159
		Male					3	3	3	1	4	4	6	6	3	1		34
		Total			3	12	15	18	15	16	21	22	42	15	9	5		193
7.	Musca sorbens	Female					4	4	8	6	20	10	12	9	5	7	4		89
		Male						2	2	6	4	8	4	7	8	3	2		46
		Total					4	6	10	12	24	18	16	16	13	10	6		135
8.	Musca lucens	Female					4	8	10	6	5	8	12	12	10	6	3	1	85
		Male					2				2	2	4	6		2			18
		Total					6	8	10	6	7	10	16	18	10	8	3	1	103
9.	Other Muscids	Female						1	6			4	1	1	1	6	3		23
		Male								2							1		3
		Total						1	6	2		4	1	1	1	6	4		26
10.	Muscid	Total				3	22	30	44	35	47	53	55	77	39	33	18	1	457
11.	*Sarcophagids	Female					4	2	2	2	2	2	4	2	6	2			28
		Male			2					6	2						2		12
		Total			2	4	2	2	8	4	2	4	2	6	2	2			40
	Total Flies				75	210	221	241	287	318	394	418	615	318	289	250	32		3366
	Hourly mean temp. °C		24.5	24.5	25	26.3	28	29	29.5	30.5	31	31	31	31.5	30	29.5	29.5		
	Hourly relative humidity %		92	96	92	88	77	74	79	81	79	79	79	81	82	85	85		
	Visibility		0.8	1.6	60	100	175	200	250	300	300	400	150	140	65	40	1.6		

*The number of different Sarcophagid flies are so insignificant that they were not considered here.

Table No. 8. Meteorological data of the trapping sites of Jalpaiguri Tow (corrected with the data obtained by Regional Meteorological Centre, Alipore, Calcutta for Jalpaiguri).

Date.		HOURS															
		3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19
25.6.75	Temperature in °C	24.0	24.5	25	25	25.5	26.0	28.5	29.0	32.5	33.0	32.5	33.0	31.5	30.5	29.5	28.0
	Humidity in %	96	96	92	96	92	92	88	73	73	76	76	73	76	82	88	96
	Visibility*	0.8	1.6	4.2	15	37	100	200	250	350	300	200	300	200	100	25	0.8
	Rainfall in cc	210	230	260	89	65	43	3	5								
26.6.75	Temperature in °C	25	25.5	26	28.5	29.0	31.0	32.0	32.0	32.0	33.0	33.5	33.5	33.5	32.5	31.5	29.5
	Humidity in %	96	92	96	92	85	81	76	76	82	76	73	73	70	76	79	85
	Visibility*	0.8	13	87	200	200	300	250	175	400	350	350	250	350	200	100	0.9
27.6.75	Temperature in °C	25.5	25.5	26	26.5	28.0	29.0	29.5	30.0	30.0	31.5	31.5	31.5	30.5	29.5	27.0	27.0
	Humidity in %	96	96	92	92	88	8	84	81	81	79	76	76	85	81	96	92
	Visibility*	0.8	5.2	16	75	125	150	75	200	225	350	350	200	130	85	13	0.9
	Rainfall in cc				5			60	30					5	50	100	80
28.6.75	Temperature in °C	24.5	24.5	25.0	25.5	27.0	27.5	28.0	28.0	29.0	29.5	30.5	30.5	32.0	30.0	29.0	29.0
	Humidity in %	96	96	96	96	92	92	92	88	88	81	78	75	73	81	84	84
	Visibility*	0.9	4.5	37	75	125	225	225	125	300	350	325	175	300	90	19	0.9
	Rainfall in cc				5	10	10			3							
7.9.75	Temperature in °C	25	26	25.5	25.5	27.0	27.0	29.5	31.5	30.5	30.5	31.0	31.5	28.0	27.5	27.0	
	Humidity in %	96	95	96	96	92	88	78	79	81	84	75	78	85	85	91	
	Visibility*	0.8	0.8-1.6	25	75	125	175	200	300	400	175-300	225	375-400	50-75	50	0.8	
	Rainfall in cc													5	30		
11.9.75	Temperature in °C	25	25.0	24.5	26.5	28.0	31.5	32.0	33.0	29.0	29.5	30.5	29.5	29.0	29.0	28.5	
	Humidity in %	91	92	96	92	81	75	66	67	75	78	81	78	78	85	85	
	Visibility*	0.8	1.6	65	150	200	250	225	275	100	175	250	175	125	60	0.8-1.6	
	Rainfall in cc			3						60	5						
28.9.75	Temperature in °C	24.5	24.5	25.0	26.5	28.5	29.0	29.5	30.5	31.0	31.0	31.0	31.5	30.0	29.5	29.5	
	Humidity in %	92	96	92	88	77	74	79	81	79	79	79	81	82	85	85	
	Visibility*	0.8	1.6	60	100	175	200	250	300	300	400	150	140	65	40	1.6	

*This data was obtained through a photo exposure meter.

Table No. 9a. Feeding, mating, oviposition and pupal emergence activity of Chrysomya megacephala.

ATE	FEEDING							
	HOURS OF OBSERVATIONS							
	4.30	6.30	8.30	10.30	12.30	14.30	16.30	18.30
.5.78		2	7	13	4	15	5	4
.5.78		1	5	21	6	19	7	2
.5.78			11	16	4	22	4	3
.5.78		3	7	12	5	21	4	1
.5.78		3	3	11	5	16	6	2
.5.78		2	6	9	7	20	13	4
.5.78		5	10	17	6	17	10	3

	MATING							
	HOURS OF OBSERVATIONS							
	4.30	6.30	8.30	10.30	12.30	14.30	16.30	18.
							2	
		2				1	3	
						1		
						2	4	
						3		1
						1	2	
		1					2	1

	OVIPOSITION							
.5.78						3		
.5.78						2		
.5.78					1			
.5.78	1					1		
.5.78	3							
.5.78	2							
.5.78						2		

	PUPAL EMERGENCE							
							✓	
							✓	
						✓	✓	
							✓	
							✓	
						✓	✓	
							✓	

Table No. 9b. Feeding, mating, oviposition and pupal emergence activity of Chrysomya rufifacies.

DATE	FEEDING							
	HOURS OF OBSERVATIONS							
	4.30	6.30	8.30	10.30	12.30	14.30	16.30	18.30
18.5.78		4	9	12	4	16	6	4
19.5.78		6	9	21	1	18	8	5
20.5.78		1	6	15	3	17	2	3
21.5.78		3	7	15	4	21	4	4
22.5.78		4	4	13	3	19	5	1
23.5.78		2	12	12	4	17	5	2
24.5.78		2	8	19	3	18	9	3

DATE	MATING							
	HOURS OF OBSERVATIONS							
	4.30	6.30	8.30	10.30	12.30	14.30	16.30	18.30
18.5.78						2		
19.5.78							1	
20.5.78								
21.5.78						1	1	
22.5.78						2	1	
23.5.78						1		
24.5.78								1

DATE	OVIPOSITION
18.5.78	2
19.5.78	1
20.5.78	3
21.5.78	2
22.5.78	
23.5.78	
24.5.78	

DATE	PUPAL EMERGENCE
18.5.78	✓
19.5.78	✓
20.5.78	✓
21.5.78	✓ ✓
22.5.78	✓
23.5.78	✓
24.5.78	✓

Table No. 9c. Feeding, mating, oviposition and pupal emergence activity of Musca domestica.

DATE	FEEDING							
	HOURS OF OBSERVATIONS							
	4.30	6.30	8.30	10.30	12.30	14.30	16.30	18.30
18.5.78		3	9	8	2	17	2	2
19.5.78		2	7	10	8	15	5	3
20.5.78		5	10	26	6	14	5	4
21.5.78		3	18	17	3	21	9	5
22.5.78		2	21	12	6	20	6	3
23.5.78		2	18	16	17	18	6	2
24.5.78		3	10	14	3	11	3	1

DATE	MATING							
	HOURS OF OBSERVATIONS							
	4.30	6.30	8.30	10.30	12.30	14.30	16.30	18.30
18.5.78						2	1	
19.5.78						1		
20.5.78						3		
21.5.78								1
22.5.78						2	3	
23.5.78						3	1	
24.5.78						1	1	

DATE	OVIPOSITION							
18.5.78	1							
19.5.78						2		
20.5.78	4							
21.5.78	2							
22.5.78								
23.5.78						2		
24.5.78	1							

DATE	PUPAL EMERGENCE							
18.5.78						✓		
19.5.78						✓		
20.5.78					✓			
21.5.78						✓		
22.5.78						✓		
23.5.78					✓			
24.5.78					✓	✓		

Table No. 9d. Feeding, mating, oviposition and pupal emergence activity of Musca sorbens.

DATE	FEEDING							
	HOURS OF OBSERVATIONS							
	4.30	6.30	8.30	10.30	12.30	14.30	16.30	18.30
18.5.78		4	16	18	5	19	12	3
19.5.78		5	12	16	3	23	1	4
20.5.78		3	16	19	4	21	5	4
21.5.78		3	8	15	6	19	5	2
22.5.78		4	19	21	2	16	6	3
23.5.78		5	5	13	7	21	2	2
24.5.78		2	7	19	5	17	4	4

DATE	MATING							
	HOURS OF OBSERVATIONS							
	4.30	6.30	8.30	10.30	12.30	14.30	16.30	18.30
18.5.78						3		
19.5.78						3	3	
20.5.78						2		1
21.5.78						1	1	
22.5.78						1		
23.5.78							1	
24.5.78						1	2	

DATE	OVIPOSITION							
18.5.78		1						
19.5.78								
20.5.78		1						
21.5.78								
22.5.78								
23.5.78								
24.5.78							2	

DATE	PUPAL EMERGENCE							
18.5.78						✓		
19.5.78						✓		
20.5.78					✓	✓		
21.5.78					✓	✓		
22.5.78						✓		
23.5.78						✓		
24.5.78						✓		

Table No. 9e. Feeding, mating, oviposition and pupal emergence activity of Musca lucens.

DATE	FEEDING								MATING							
	HOURS OF OBSERVATIONS								HOURS OF OBSERVATIONS							
	4.30	6.30	8.30	10.30	12.30	14.30	16.30	18.30	4.30	6.30	8.30	10.30	12.30	14.30	16.30	18.30
18.5.78		3	12	18	4	23	3	2						2	2	
19.5.78		3	18	19	5	21	1	2						1	1	
20.5.78		2	9	16	6	12	4	3								
21.5.78		4	8	18	3	17	2	1								
22.5.78		6	17	15	6	19	3	3						1	3	
23.5.78		2	16	18	2	20	6	4						2		
24.5.78		2	13	15	3	18	6	3							1	

	OVIPOSITION	PUPAL EMERGENCE
18.5.78	1	✓
19.5.78		✓
20.5.78		✓ ✓
21.5.78		✓
22.5.78	2	✓
23.5.78		✓
24.5.78	1	✓

Chapter - IV

STUDIES ON THE DEGREE OF DOMESTICATION AND RELATIVE DANGEROUSNESS OF SYNANTHROPIC FLIES.

INTRODUCTION

The term 'Synanthropy' indicates degree of liking of flies to the density of human settlements. It was observed by various workers (Power and Melnick, 1945; Melnick et al., 1947; Hall, 1948; Schoof and Savage, 1955 and Schoof et al., 1956) that in North America the degree of synanthropy of Lucilia illustris increased from south to north. Gregor and Povolny (1958, and 1960a, 1960b, 1960c and 1964) reported that Lucilia sericata was a highly synanthropic fly in Czechoslovakia, but was asynanthropic in Hungary. Lucilia caesar and Calliphora vicina (=erythrocephala) were synanthropic in Hungary and Czechoslovakia but the synanthropy of L. caesar decreased further south in Europe. These authors further reported that Calliphora vomitoria and Lucilia sylvarum were asynanthropic in Hungary and in Czechoslovakia. Vashinskaya (1957) and Lineva (1964) reported that the synanthropy of flies was [redacted] associated with the eadophily of flies. In Czechoslovakia the incidence of Phormia terraenovae was not depeadent on the human settlement and was found in Prague as well as in the surrounding mountainous regions (Gregor and Povolny, 1958 and Havlik and Batova, 1960). In Russia Derbeneva - Ukhova (1962) found Calliphora uralensis in urban areas, in rural surroundings and in taiga forest zones.

Nuorteva (1963) in his detailed studies on the synanthropic behaviour of blow-flies in Finland noted that Phormia terraenovae was asynanthropic in oak and in coniferous forest zones and in the smallest islets in the lake Kallavesi, but was synanthropic in the archipelago of the lake Inarijarvi, and also at the border between coniferous forest and subarctic zones. He further reported that Lucilia caesar, C. erythrocephala and C. uralensis exhibited either very little or complete asynanthropic behaviour at the border between coniferous forest and oak zones, while L. illustris, C. vicina (=erythrocephala) and C. uralensis exhibited synanthropic behaviour at confferous forest at the border between coniferous and oak zones. Nuorteva and Leuri Kainen (1964) in a subsequent work noted that C. erythrocephala and L. illustris were asynanthropic flies in Götland, Sweden. In south Finland Calliphora loewi, C. subalpina, C. erythrocephala and C. vomitoria were available both in the human settlement and in the forest but P. terraenovae, Lucilia sericata, L. sylvarum, L. illustris and L. caesar were strictly confined to human settlement only (Nuorteva, 1966). Nuorteva and Vasikari (1966) noted that L. illustris and C. erythrocephala exhibited asynanthropic behaviour in arctic region in the north. C. uralensis, Muscina assimilis and Cyrtoneyia mortuorum were available both in human settlement and in forest zones. According to Kano and Okasaki (1955) and

Kano and Morikawa (1957) C. erythrocephala was synanthropic but C. yomitoria was asynanthropic in Japan. Suenaga et al., (1964) reported that Chrysomya megacephala was predominant in Nagasaki and less common in Yamaguchi but was absent in Fukui prefecture.

Gregor and Povolny (1958) while trying to construct the ecological system of synanthropic flies, classified those flies into eusynanthropic (living in human settlement), hemi-synanthropic (living in free nature) and asynanthropic species. These authors further subdivided eusynanthropic species into endophilous and exophilous groups, on the basis of their habit of visiting human dwellings or staying out of it. They also divided the subgroup into communicative and accommunicative species, the former visiting faeces, meat and fruit alternatively and the latter visit of either faeces or meat but never the both. Mihalyi (1967b) in his work with synanthropic flies in Budapest divided eusynanthropic flies into two subgroups, the rural and the urban synanthropic fly fauna. He further stated that flies visiting fruits only should be considered as communicative because fruits are consumed raw by human beings. In Siliguri, India, Roy and Dasgupta (1980) calculated the synanthropic indices for flies and showed that Chrysomya megacephala, Musca domestica and M. sorbens were more synanthropic than Hemipyrellia

ligurriens, M. ventrosa, Sarcophaga (=Iranihindia) futilis, S (=Seniorwhitea) orientaloides, S (=Parasarcophaga) brevicornis, S (=Pierretia) calcifera and Anthomya illocata. They also observed that in uninhabited shady forest area the males of C. megacephala, S. orientaloides and A. illocata occurred in greater number than the females of the corresponding species. Synanthropic behaviour of Calliphorid flies in Calcutta was studied by Das (1980) who observed that C. megacephala, C. rufifacies, Lucilia cuprina and H. ligurriens were synanthropic in nature. This author also revealed that in West Bengal synanthropic index for C. rufifacies, and L. cuprina decreased from north to south whereas it increased in the case of C. megacephala, in the same direction.

Nuorteva (1963) tried to express the grade of synanthropy numerically. According to his system synanthropic index ranges between +100 and -100, where positive sign indicated the liking for man-made environment and negative sign indicates dislike for man-made environment.

Mihalyi (1967a) stated that index based on the number of percentages of synanthropic flies expressed only the grade of domestication but not true synanthropy. He further stated that synanthropy, in epidemiological sense means the dangerousness of the species as carriers of infection and the true synanthropic index should be the danger index. The same

author calculated relative dangerousness of different species of flies in Budapest according to their epidemiological significance.

Keeping in view the formulations of both Nuorteva (1963) and Mihalyi (1967a) the present work was undertaken to find out the correlation, if any, between the degree of domestication based on Nuorteva indices for different synanthropic flies of the area and their relative dangerousness (calculated according to Mihalyi's system) as carriers of infection.

MATERIAL AND METHOD

Traps used for the purpose of experiment were made of wire-net of fine mesh and were cylindrical in shape (see fig. 4). Each trap was 40 cm high with a diameter of 25 cm. Wire-net of 30 cm long was fitted around the outer margin of two circular iron-rings of 25 cm diameter. The two circular rings were 30 cm apart from each other. The upper opening of the cylindrical wire-net was covered with a detachable lid, made of same type of wire-net and supported by a circular ring of the same diameter. The lid could be fitted tightly along the inner margin of the cylindrical trap. Lower opening was covered with a fixed 20 cm long conical structure made of same wire-net. Narrower end of the cone was directed inward and was with a gap of 2 cm at the top.

The above trap with 250 gm of raw fish as bait was operated from 6 am to 6 pm in each trapping site on all the trapping days. Each trapping period was of three days' duration. Bait of each trap was renewed on every alternate day in order to maintain efficacy of the attractants, and the collection of flies from the traps was made every day after sunset. As a precautionary measure against predators and intruding animals, the trap was covered by a large outer cage

made of expanded metal. The traps along with the outer cover were exposed to sun-light and air from all directions.

Simultaneous trappings were made in three different localities of Jalpaiguri Town with a view to calculate the synanthropic index i.e., degree of domestication and relative dangerousness of medically important flies (viz., Calliphoridae Muscidae and Sarcophagidae). Three localities of Jalpaiguri Town with different densities of human population were selected for the experiment. These localities are as follows :-

(1) Fire Brigade compound - This compound is at the south-eastern part of the town and is situated by the side of Municipal market and comprises of an area of 4180.60 sq.m. Two residential quarters, one barrack with kitchen and a garrage-cum-office are present within the compound and the rest is open ground covered with grasses and some seasonal herbs. Sewage disposal and drainage system of the area is poorly developed. Marshy land, open drains and thatched huts are present on the eastern side of the compound wall. The trap was placed at a corner of the Fire Brigade compound close to the kitchen and was exposed to sun-light from all directions.

(2) Mohitnagar (Thinly populated area) - It is a village situated by the side of Siliguri-Jalpaiguri Highway, 12 km north-west of the town. The village consists of

about fifteen thatched houses surrounded by agricultural field and two ponds. The hygienic and sanitary conditions of the village are poor. Service latrines and privy pits are common. The trap was placed in the middle of a field measuring 10117.15 sq.m. On the south-eastern side of the field a thatched house and a pond are present. The trap was fully exposed to sun-light and air throughout the day.

(3) Uninhabited field - This trapping site is about 10km on the south-western side of Jalpaiguri Town and 8 km south-east of Mohitnagar village. This area is a vast expanse of agricultural fields, marshy lands, stagnant water pools and is completely uninhabited. The nearest habitation is about 8 km on the north-western side of the site. The trap was placed inside a paddy field on a wooden platform 1.5 m above ground level and was exposed to sun-light and air from all directions.

For calculating the synanthropic indices or grade of domestication for different synanthropic flies, formula given by Nuorteva (1963) has been followed. The formula runs as -

$$\text{Synanthropic index} = \frac{2a + b - 2c}{2}$$

where 'a' = percentage of a fly species in thickly populated area i.e., town.

'b' = percentage of the same fly species in thinly populated area i.e., village and

'c' = percentage of the same fly species in an uninhabited area.

Percentages of individual fly species were calculated in relation to total number of flies trapped in three localities viz., a, b, and c. Synanthropic index ranges between ± 100, + 100 representing the highest degree of synanthropy or highest liking of each species to man-made environment and -100 representing the lowest degree of synanthropy or the lowest degree of liking to man-made environment.

For calculating the relative dangerousness of the synanthropic flies, the formula developed by Mihalyi (1967a) has been followed.

This formula is as follows :

Dangerousness = Ability to undergo infection × Ability of a species to pass infection × Relative size.

or

$$D = (a + b + c + d) (e + f + g) m$$

where 'a' = A fly species visiting human faeces for egg-laying, hunting ground etc.

'b' = A female feeding on faeces.

'c' = A male feeding on faeces.

'd' = A fly species feeding on other infectious secretions like sputum, pus, urine, sweat etc.

'e' = Domestication of a species i.e., visit to human home, court-yards, streets, settlements etc.

'f' = Visit of the species to meat, milk and other foods of animal origin.

'g' = Visit of the species to fruits and sweet meat*

'm' = Relative size i.e., volume of the species in relation to Musca domestica.

Volume of a fly = Breadth of the head X height of the thorax X length of body (without antenna and ovipositor).

For putting the value of each determinant in formula a positive case is designated by one (1) and negative by zero (0).

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* In India, sweetmeat also attracts flies like fruits and is eaten without further cooking. Mihalyi (1967a) considered only the visit of flies to fruit for calculating the volume 'g' and in consideration of communicative/accommunicative species. The present author is of the opinion that sweetmeat in the study area is as important as fruit. As such, sweetmeat has been taken into consideration for calculating the value of 'g' and in the interpretation of communicative species in the present work.

OBSERVATION AND DISCUSSION

Results of trapping :

Total number of flies trapped during the period of experiment were 9083 only. Trapped flies consisted of 30 species belonging to three families viz., Calliphoridae (8344 or 90.86% of the total catch), Muscidae (528 or 5.74% of the total catch) and Sarcophagidae (311 or 3.38% of the total catch).

Calliphorid flies were represented by six species. Chrysomya megacephala was the most dominant species (7989 or 95.45% of the total Calliphorids); followed by Hemipyrellia ligurriens (144 or 1.72 % of the total Calliphorids); Chrysomya rufifacies (125 or 1.49% of the total Calliphorids); H. pulchra (60 or 0.71% of the total Calliphorids); Lucilia cuprina (23 or 0.27% of the total Calliphorids) and Lucilia sericata (3 or 0.03% of the total Calliphorids). Lucilia sericata was present only in the catches from the town.

Muscid flies consisted of twelve species only. Musca lucens (303 or 57.38% of the total Muscids) was the most dominant Muscid fly, followed by M. domestica (65 or 12.31% of the total Muscids); Ophyra chaloogaster (60 or 11.36% of the total Muscids); M. sorbens (45 or 8.52% of

the total Muscids); M. ventrosa (28 or 5.3% of the total Muscids) M. pattoni (10 or 1.89% of the total Muscids); M. orassirostris (6 or 1.13% of the total Muscids) and M. fasciata (5 or 0.94% of the total Muscids). Only two species each of O. leucostoma and Dichaetomia[1] sp and one species each of Stomoxys calcitrans and Synthesomia nudiseta were trapped. M. fasciata, O. leucostoma, S. calcitrans and S. nudisetta were trapped in town only. M. ventrosa and Dichaetomia[1] sp were absent in the catches of village and open field respectively.

Sarcophagid flies trapped in this study area consisted of twelve species only. Parasarcophaga albiceps (90 or 28.93% of the total Sarcophagids) was the most dominant species, followed by P. brevicornis (56 or 18% of the total Sarcophagids); P. knabi (44 or 14.14% of the total Sarcophagids); P. ruficornis (42 or 13.5% of the total Sarcophagids); Boettcherisca peregrina (35 or 11.25% of the total Sarcophagids) P. orchidea (18 or 5.78% of the total Sarcophagids); P.misera (14.or 4.5% of the total Sarcophagids) and Seniorwhitea krameri (4 or 1.28% of the total Sarcophagids). Only two species each of Parasarcophaga hirtipes, Iranihindia martellata, Pierretia calicifera and Bercaea haemorrhoidalis were trapped. P. calicifera and B. haemorrhoidalis were trapped in the

uninhabited field and in the town but not in thinly populated area. P. hirtipes and I. martellata were absent in village and town populations respectively.

Synanthropic index, Danger index and their significance :

Synanthropic indices or degree of domestication of main eighteen species were calculated on the basis of Nuorteva formula (1963) are shown in table I. Synanthropic indices for flies numbering less than ten were not calculated because their numbers in all three localities were small. It is seen from this table that all species were found in large numbers among the catches from the town, excepting Parasarcophaga orchidea and Boettcherisca perigrina, which were found in greater numbers in catches from uninhabited field. Hemipyrellia ligurriens showed an index of + 94.43 indicating highest degree of synanthropy. Other highly domesticated species were M. pulchra (+ 92.5), Chrysomya megacephala (+ 87.34), Musca domestica (+ 86.15), M. ventrosa (+ 85.71), M. lucens (+ 79.03), C. rufifacies (+ 76.8), M. pattoni (+ 75.0), Ophyra chalcogaster (+ 72.5), Lucilia cuprina (+ 63.04), M. sorbens (+ 55.55) and P. albiceps (+ 52.77).

C. megacephala though trapped in far greater number than any other species from all the three localities showed lesser degree of domestication than H. ligurriens and H. pulchra. P. orchidea and B. perigrina with their indices

- 36.05 and - 17.14 respectively indicated their aversion to man-made condition.

Some degree of variations were noted (see table No. II) in respect of the degree of domestication of synanthropic flies when the result of the present investigation were compared with those of Siliguri (Roy and Dasgupta, 1980) and Calcutta (Das , 1980). It is seen from the table that C. megacephala, C. rufifacies, M. domestica, M. sorbens, M. lucens, P. misera and P. ruficornis in Siliguri-Jalpaiguri area as well as C. megacephala and C. rufifacies in Calcutta were highly domesticated urban flies. H. ligurriens, M. ventrosa and P. bravicornis showed their marked liking to man-made environment in Jalpaiguri, quite contrary to their behaviour in Siliguri. H. ligurriens and L. cuprina exhibited positive synanthropic index both in Calcutta and in Jalpaiguri. It was also noted that C. megacephala, M. domestica, M. sorbens, P. misera and P. ruficornis were more domesticated in Siliguri than in Jalpaiguri. Similarly, degree of domestication in case of C. megacephala and L. cuprina was higher in Calcutta than in Jalpaiguri.

The scale of synanthropic fly arranged according to Nuorteva indices differs considerably from the scale calculated for Siliguri. This is possibly due to the warmer and more moist climate in the study area. In the study area flies showed high synanthropic indices, viz., H. ligurriens (+ 94),

H. pulchra (+ 92), C. megacephala (+ 87) and M. domestica (+ 86) occurred also in the wild. White B. perigrina (- 17) a wild species was also found in urban area of Jalpaiguri Town. Similarly in Siliguri (Roy and Dasgupta, 1980) C. megacephala (+ 91.6), C. rufifacies (+ 77) and M. lucens (+ 75) were also trapped as wild species. Likewise, H. ligurriens (- 37.5) and S (=Iranihindia) futilis were trapped from town area only.

Since the index based on percentages of flies may not reflect the true nature of the fly in epidemiological sense as suggested by Mihalyi (1967a), an effort was made to correlate the degree of domestication with relative dangerousness of synanthropic urban fauna of the study area, taking into consideration not only their numbers but also their habits and their average sizes.

Average sizes and danger indices of main eighteen species of flies are given in tables III and IV respectively. It is noted from table IV that H. ligurriens is relatively more dangerous fly with highest danger index of 24.66. Other species with sufficiently higher danger indices are P. misera, P. ruficornis, B. perigrina, H. pulchra, P. knabi and P. albiceps. The species with quite high danger indices and low percentages of occurrence have thrust into the back-ground other flies which are trapped in far greater numbers.

H. ligurriens with its highest degree of domestication and danger index is capable of spreading infection more efficiently than C. megacephala or M. lucens which out-numbered it in all three localities. P. misera, P. rufiornis, P. knabi and P. albiceps with their high danger indices and lesser degree of domestication seems to have lesser chances of spreading disease than H. ligurrione, B. perigrina and P. orchidea. These insects even with sufficiently high danger indices are of very little importance in the study area because of their marked aversion to anthropobiocoenosis. H. pulchra with its danger index 12.6 and very high degree of domestication +92.5 is more dangerous as potential carrier of infection. On the other hand C. megacephala with its comparatively low danger index (9.12) has much greater chances of spreading infection because of its vastly superior percentages in urban, rural and uninhabited field.

The danger indices given in table IV are relative dangerousness which in fact does not express how many times more bacteria can one species transmit than the other (Mihalyi, 1967a). In order to find out the real significance of a particular species in a fly population, danger index should be multiplied by its numbers or percentages. The value thus obtained, though statistically not quite correct, may give a true picture about the probable share of transmission of

diseases by each species (Mihalyi, 1967).

A comparative list of flies caught in a village and in a food market of Jalpaiguri Town with their percentage population corrected by their danger indices are shown in table V. It is noted in this table that the real significance of the species is completely altered when the number of flies are multiplied by their danger indices. C. megacephala and M. domestica which have a lower danger indices of 9.12 and 9 respectively becomes 74 and 10 times more dangerous than the flies with much higher relative dangerousness i.e., H. ligurriens (24.66), P. misera (21.6), P. ruficornis (14.1), B. perigrina (13.8), H. pulchra (12.6), P. knabi (12) and P. albiceps (10.8) in the study area. It is worthwhile to record here that C. megacephala and M. domestica with quite high degree of domestication may be highly dangerous flies because of their far greater protentiality as carriers of infections.

Mihalyi (1967b) while developing further on the ecological system of synanthropic flies (Gregor and Povolny, 1958) created two sub-group among eusynanthropic flies viz., urban and rural synanthropic fly fauna. He further noted that the main character of urban fauna was the high percentage of flies developing in or feeding on human faeces while the main characteristics of rural fauna was the dominance of species developing in the dung of domestic animals. The

author cited M. domestica and S. calcitrans as completely rural species and L. sericata as urban species. On examination of the fly fauna of the study area it was found that the above findings do not correspond with the situation prevailing in Jalpaiguri-Siliguri area, because the above breeding media (Human faeces and dung of domestic animals) are equally available in urban as well as in rural areas.

Roy and Dasgupta (1973 and 1975) noted that M. domestica was found in much greater abundance in urban area and S. calcitrans was only trapped in the city in very small numbers in Siliguri. This finding seems to be true for Jalpaiguri area also. In the present investigation M. domestica was found in greater abundance in the town population than in rural population, while S. calcitrans was trapped only in the town. The study also revealed that eusynanthropic flies of the Jalpaiguri-Siliguri area could not be devided into urban and rural faunas on the basis of breeding medias only as suggested by Mihalyi (1967). Most of the flies of the study area which predominantly breeds on animal dung and human faeces are more or less distributed in urban as well as in rural areas though their number varies considerably. Therefore no sharp distinction can be made among urban and rural fly population on the basis of breeding media only.

The occurrence of most of the flies studied here are found in urban as well as in rural ~~fit~~ areas irrespective of their preference to breeding media. This may be attributed to the poor sanitary and unhygienic conditions prevelent in the study area and also, because the flies encroach upon each others' territory.

The eighteen communicative and accommunicative species studied here are commented upon as follows :-

1) Chrysomya megacephala (Fabricius, 1784):

This is a highly synanthropic, accommunicative, wdl distributed, predominantly urban species with high degree of danger index. This haliophilic fly shows maximum seasonal occurrence in the months of May and September while its numbers decrease from October to February. This fly is likely to produce at least four generations in a year and is easily attracted to banana, pineapple, mango, jackfruit, mustard oil flake - cow dung mixture, rotten egg, meat and fish, but shows its marked preference for raw fish. This fly can cause myiasis in domesticated animals as secondary invader in association with Chrysomya bezziana (Roy and Dasgupta, 1975) and this fly has been found to be associated with various pathogenic organisms(Asahina et al., 1963, Harris and Down, 1946; Shimusu et al., 1965).

2) Chrysomya rufifacies (Macquart, 1842) :

This is a synanthropic, accommunicative, heliophilic, widely distributed and predominantly rural species in the study area. This fly shows bimodal seasonal abundance curve in the months of May and October. This species produces at least four generations in a year and is easily attracted to pineapple, jackfruit, mango and fish, but shows its highest preference to raw fish. C. rufifacies can cause sheep myiasis in India (Choudhury, 1961) and has been found to be associated with pathogenic organisms(Morellini and Cattaneo, 1947).

3) Hemipyrellia ligurriens (Wiedemann, 1830) :

This is a highly synanthropic, communicative, scotophilic, relatively dangerous, urban species in the study area. This species shows trimodal seasonal abundance curve in the month of March, May and August and are more or less equally active throughout the year except in winter. This fly produces at least five generations in a year and are easily attracted to fish, meat, rotten egg, human faeces and banana, but shows its marked preference to raw fish. Larval parasitism of this species has been noted by Roy and Dasgupta (1975).

4) Hemipyrellia pulchra (Wiedemann, 1830) :

This m is a synanthropic, accommunicative, relatively dangerous urban species in the study area. This species

shows steady occurrence from March to December with its maximum abundance in August. H. pulchra can produce at least five generations in a year and are easily attracted to human faeces, cow-dung and raw fish but shows its highest preference to human faeces.

5) Lucilia cuprina (Wiedemann, 1830) :

This is a synanthropic, acommunicative, widely distributed urban species in the study area. This species is much more abundant in March, while its abundance decreases during rains and in cold climatic conditions. L. cuprina can produce at least three generations in a year and are attracted to cow-dung, rotten egg, meat and fish with its marked preference for rotten egg. This fly can cause myiasis (Sinton, 1921; Senguta, Menon and Basu, 1951) and can carry ova of Ascaris lumbricoides (Roberts, 1934).

6) Musca domestica (Linnaeus, 1758) :

This is a highly synanthropic, communicative, widely distributed, predominantly urban species of the study area and is equally available in sunshine and in shade. Maximum abundance of this species occurs in May while its abundance decreases during rain and in cold climatic conditions. This species produces at least three generations in a year and are easily attracted to banana, pineapple, mango, jackfruit,

mustard oil flake - cow-dung mixture, molasses, human faeces, rotten egg, meat and fish, but shows its marked preference to ripe mango. This fly can cause intestinal myiasis (Zumpt, 1965) and have been found associated with various pathogenic organisms (Merk, 1910; Mohler, 1920; Rinonapoli, 1930; Roberts, 1947; Rendtorff and Halt, 1954; Prado and Jmenes, 1955; Coutinto et al., 1957; Greenburg, 1959; Gudanodóttir, 1960; Lysenko and Povolny, 1961; Riordan et al., 1961; Greenburg and Burkmann, 1963 and Zardi, 1964).

7) Musca sorbens (Wiedemann, 1830) :

This is a synanthropic, communicative, widely distributed, predominantly urban species of the study area. Maximum seasonal abundance of this species occurs in May and is available throughout the year. This species is equally available in sunny as well as in shady areas and produces at least five generations in a year and are easily attracted to banana, pineapple, mango, jackfruit, mustard oil flake - cow-dung mixture, molasses, cow-dung, rotten egg, meat and fish, but shows its marked preference to mango and mustard oil flake - cow-dung mixture. This fly has been found to have been associated with various pathogenic organisms (Gear et al., 1962; Chang, 1940; Lamborn, 1935, '36, '37 and '38; Cleland, 1913).

8) Musca lucens (Villeneuve, 1922) :

This is a synanthropic, communicative, scotophilic, widely distributed species of urban and rural areas and also available from open fields and uninhabited forest areas of Jalpaiguri District. This species shows bimodal seasonal prevelence curve and its abundance decreases during rains. This species produces many generations in a year and are attracted to all the used baits for the present study but shows its marked preference for mango bait.

9) Musca pattoni (Austen, 1910) :

This is a synanthropic, communicative, heliophilic, predominantly urban species in the study area. This species exhibits maximum abundance in May and is likely to produce at least five generations in a year. M. pattoni is easily attracted to pineapple, mango, jackfruit, mustard oil flake - cow-dung mixture, molasses and fish but shows its marked preference for mango and mustard oil flake - cow-dung mixture bait.

10) Musca ventrosa (Wiedemann, 1830) :

This is a synanthropic, communicative, heliophilic, haematophague (Van Emden, 1965) predominantly rural species of the study area and exhibits bimodal (April and September) seasonal prevelence curve. Abundance of this species decreases during rains and in cold climatic conditions. This

species produces at least five generations in a year and van Emden, 1965 was trapped in fish-baited traps during the study of seasonal occurrence of flies but not during the study of efficacy of attractants.

11) Ophyra chaleogaster (Wiedemann, 1830) :

This is a accommunicative, synanthropic, heliophilic, urban species of the study area. This fly exhibits highest abundance in May and September and its abundance decreases during rains. This species produces at least five generations in a year and are attracted to cow-dung, rotten egg and fish bait but shows its marked preference for fish bait.

12) Boettcherisca peregrina (Robineau-Desvoidy, 1830) :

This is a synanthropic, accommunicative, relatively dangerous species and available from open fields and forest areas of Jalpaiguri District. This species exhibits highest abundance in March, July and September. This species prefers to live in 'canopy' and is easily attracted to rotten egg, meat and fish bait and produces at least four generations in a year. This fly can cause traumatic myiasis (Patton and Evans, 1929) in India and have been found associated with pathogenic organism (Shimusu et al., 1965).

13) Parasarcophaga albiceps (Meigen, 1826) :

This is a synanthropic, communicative, widely distributed, relatively dangerous, urban species of the study area. This species is available both in sunshine and in shade. This species exhibits highest abundance in March. This species produces at least five generations in a year and readily attracted to mango, jackfruit, mustard oil flake - cow-dung mixture, molasses, human faeces, cow-dung, rotten egg, meat and fish bait but shows its marked preference to fish bait.

14) Parasarcophaga orchidea (Böttcher, 1913) :

This is a synanthropic, communicative, heliophilic species of the study area predominantly available in the north-eastern part of the District. This species exhibits highest peak in September. This species produces at least three generations in a year and is easily attracted to pineapple, jackfruit and fish bait but shows its marked preference to pineapple bait.

15) Parasarcophaga knabi (Parker, 1917) :

This is a synanthropic, communicative, heliophilic, widely distributed, urban species of the study area. This fly exhibits bimodal peak of abundance in April and October. This species produces at least four generations in a year and

is easily attracted to pineapple, mango, jackfruit, rotten egg, meat and fish bait but shows its marked preference to fish bait.

16) Parasarcophaga brevicornis (Ho, 1934) :

This is a synanthropic, accommunicative, heliophilic, widely distributed, urban species of the study area. This species exhibits bimodal peak of abundance in April and December and is available throughout the year. This species produces at least six generations in a year and is easily attracted to cow-dung, rotten egg and fish bait but shows its marked preference to fish bait.

17) Parasarcophaga ruficornis (Fabricius, 1794) :

This is a synanthropic, accommunicative, scotophilic, rural species of the study area. This fly exhibits highest occourrence in April and December. This species produces at least six generations in a year and easily attracted to pineapple, jackfruit, rotten egg and meat bait.

18) Parasarcophaga misera (Walker, 1849) :

This is a synanthropic, communicative, widely distributed, urban species of the study area. Majority of these flies prefer shade. This fly shows highest abundance in January and in September. This species produces many

generation in a year and is readily attracted to mango, mustard oil flake - cow-dung mixture, human faeces, rotten egg, meat and fish bait, but shows its marked preference to fish bait. P. *misera* is an important myiasis - producing fly (Roy and Dasgupta, 1975; Alwar and Seshiah, 1958) in India and can carry pathogenic organism also (Pipkin, 1949).

SUMMARY

(1) Simultaneous trappings of flies were made at three different localities (viz., I-Town, a thickly populated area; II-Village, a thinly populated area and III-Open field, an uninhabited area) in Jalpaiguri in the months of May and September '75 i.e., the peak period of occurrence for calculating synanthropic indices (Nuorteva, 1963) and danger indices (Mihalyi, 1967) for flies.

Among the eighteen species for which synanthropic index was calculated, Parasarcophaga orchidea and Boettcherisca peregrina showing negative synanthropic indices dominatedthe catch in the uninhabited field.

(2) Chrysomya megacephala is much greater in number than any other species trapped from all the three localities but its synanthropic index is lesser than those for Hemipyrellia ligurriens (+ 94.43) and Hemipyrellia pulchra (+ 92.5).

3) Hemipyrellia ligurriens, H. pulchra, Chrysomya megacephala, Musca domestica, M. ventrosa, M. lucens, C. rufifacies, M. pattoni, Ophyra chalcogaster, Lucilia cuprina, M. sorbens and Parasarcophaga albiceps in descending order of their synanthropic indices are highly synanthropic species in the study area.

(4) Highly synanthropic species like H. ligurriens, H. pulchra, C. megacephala and M. domestica are also found in

uninhabited area. Conversely Boettcherisca peregrina an asynanthropic species occur in urban areas.

(5) Species with higher danger indices in the study area are H. ligurriens, Parasarcophaga misera, P. ruficornis, B. peregrina, H. pulchra, P. knabi and P. albiceps.

(6) H. ligurriens with its highest degree of domestication and the highest danger index is apparently capable of spreading infection more efficiently than the numerically superior synanthropic flies like C. megacephala and M. domestica.

(7) P. misera, P. ruficornis, P. knabi, P. albiceps, B. peregrina and P. orchidea which exhibit high danger indices, are of very little importance in spreading infection because of their lesser degree of domestication and their marked aversion to human habitation.

(8) H. pulchra and C. megacephala with their comparatively low danger indices may be much more dangerous as potential carriers of infection because of their high degree of domestication.

(9) In order to find out the real significance of a particular species in transmission of diseases, danger index was multiplied by its number or percentages and it showed that C. megacephala and M. domestica are much more dangerous than the flies with much higher relative dangerousness.

(10) Most of the flies of the study area particularly M. domestica and Stomoxis calcitrans were found in urban as well as in rural areas and no sharp distinction between urban and rural fly population can be made in the study area where the available breeding media are similar.

FIGURES AND TABLES

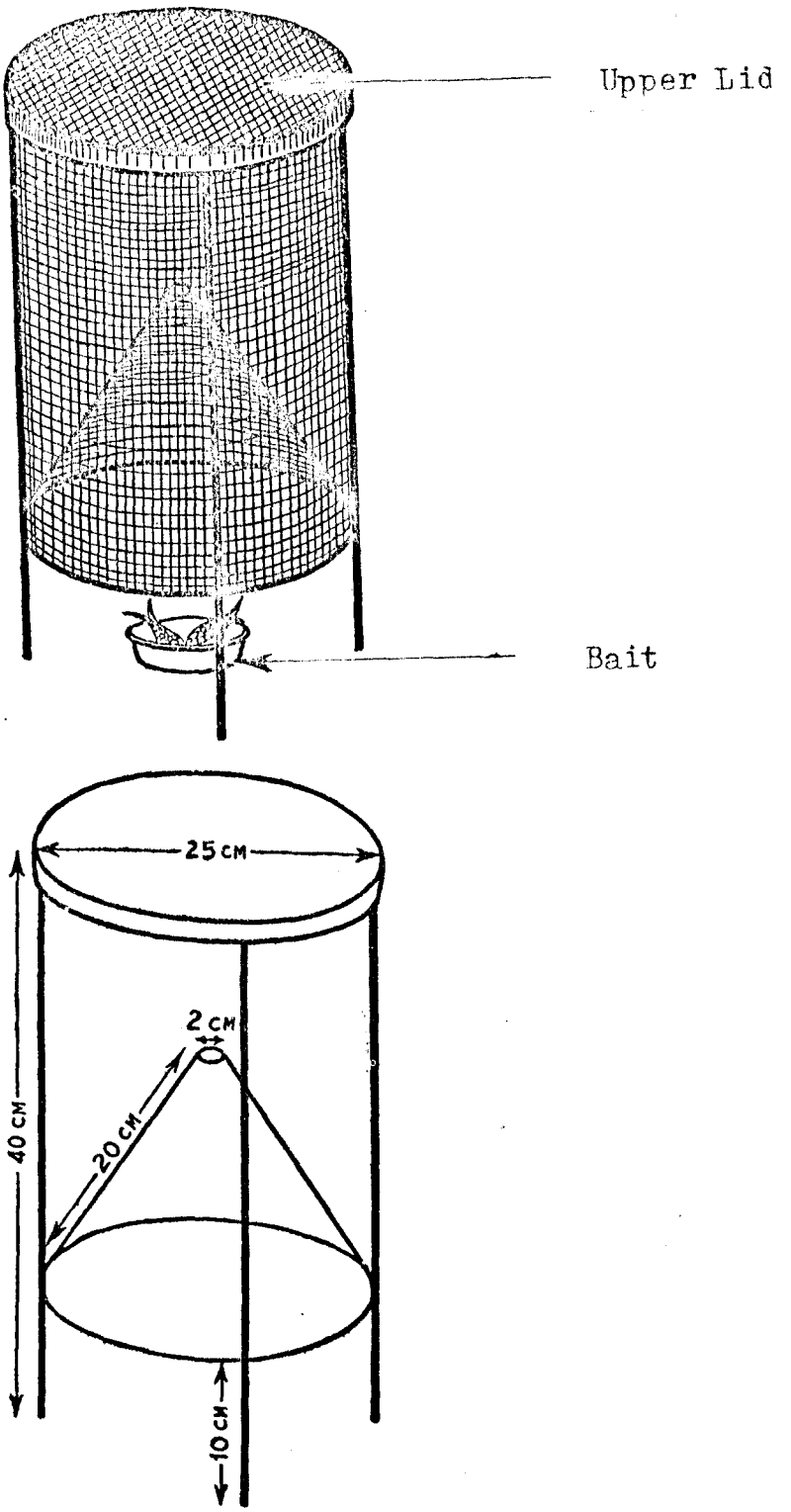

Fig. 1 Fly trap used during the experiment.

FLY TRAP INSIDE THE COMPOUND OF
MR. A. BOSE AT NEW TOWN

FLY TRAP INSIDE THE COMPOUND OF
FIRE BRIGADE STATION

Table No. 1. Nuorteva indices of synanthropic flies in Jalpaiguri Area.

FAMILY	SPECIES	Areas- Town/Thickly Populated Area			Village/Thinly Populated Area			Open field/Uninhabited Area			GRAND TOTAL	Synanthropic Index
		Female	Male	Total	Female	Male	Total	Female	Male	Total		
CALLIPHORIDAE	Chrysomya megacephala	5637	1000	6637	949	180	1129	158	65	223	7989	+ 87.34
	Chrysomya rufifacies	70	27	97	14	4	18	8	2	10	125	+ 76.8
	Hemipyrellia ligurriens	107	30	137	4	0	4	2	1	3	144	+ 94.43
	Hemipyrellia pulchra	42	15	57	1	0	1	2	0	2	60	+ 92.5
	Lucilia cuprina	9	3	12	7	2	9	2	0	2	23	+ 65.04
	Lucilia sericata	3	0	3	0	0	0	0	0	0	3	
MUSCIDAE	Musca domestica	50	3	53	9	1	10	1	1	2	65	+ 86.15
	Musca sorbens	17	6	23	13	3	16	5	1	6	45	+ 55.55
	Musca lucens	213	23	236	42	5	47	16	4	20	303	+ 79.05
	Musca pattoni	6	2	8	1	0	1	1	0	1	10	+ 75.0
	Musca ventrosa	24	2	26	0	0	0	2	0	2	28	+ 85.71
	Musca fasciata	5	0	5	0	0	0	0	0	0	5	
	Musca crassirostris	5	0	5	1	0	1	0	0	0	6	
	Ophyra chalcogaster	27	0	27	33	0	33	0	0	0	60	+ 72.5
	Ophyra leucostoma	2	0	2	0	0	0	0	0	0	2	
	Stomoxis calcitrans	1	0	1	0	0	0	0	0	0	1	
	Synthesomyia nudiseta	1	0	1	0	0	0	0	0	0	1	
	Dichaetomyia sp	1	0	1	1	0	1	0	0	0	2	
SARCOPHAGIDAE	Parasarcophaga knabi	17	6	23	8	5	13	3	5	8	44	+ 48.86
	Parasarcophaga brevicornis	25	0	25	20	1	21	10	0	10	56	+ 45.54
	Parasarcophaga ruficornis	18	0	18	12	0	12	6	6	12	42	+ 28.56
	Parasarcophaga albiceps	34	16	50	23	2	25	11	4	15	90	+ 52.77
	Parasarcophaga misera	4	4	8	3	0	3	1	2	3	14	+ 46.43
	Parasarcophaga orchidea	1	4	5	0	1	1	7	5	12	18	- 36.05
	Parasarcophaga hirtipes	0	1	1	0	0	0	0	1	1	2	
	Boettcherisca peregrina	7	3	10	2	4	6	5	14	19	35	- 17.14
	Seniorwhitea kromeri	0	3	3	0	1	1	0	0	0	4	
	Irwinbindia portellata	0	0	0	1	0	1	1	0	1	2	
	Pierretia calcifera	0	0	0	0	0	0	0	2	2	2	
	Bergesa haemorrhoidalis	2	0	2	0	0	0	0	0	0	2	

Table No. 2. Comparative Nuorteva indice Synanthropic flies in Calcutta, Siliguri* and Jalpaiguri area.

FAMILY	SPECIES	SILIGURI		JALPAIGURI		CALCUTTA	
		%	Synanthropic Index	%	Synanthropic Index	%	Synanthropic Index
	Communicative						
Calliphoridae	Hemipyrellia ligurriens	0.66	-37.5	1.56	+94.43	0.75	+59.0
Muscidae	Musca domestica	20.18	+97.6	0.70	+86.15		
	Musca lucens	1.16	+75.0	3.29	+79.03		
	Musca ventrosa	0.50	-78.4	0.3	+85.71		
Sarcophagidae	P(=sarcophaga) knabi	-	-	0.47	+48.86		
	P(=sarcophaga) albiceps	-	-	0.98	+52.77		
	P(=sarcophaga) misera	0.58	+90.6	0.15	+46.43		
	P(=sarcophaga) orchidea	-	-	0.19	-36.05		
	Accommunicative						
Calliphoridae	Chrysomya megacephala	65.63	+91.6	86.99	+87.34	91.52	+92.3
	Chrysomya rufifacies	1.08	+77.0	1.36	+76.8	7.16	+70.5
	Hemipyrellia pulchra	-	-	0.65	+92.5		
	Lucilia(=Phaenicia) cuprina	-	-	0.25	+65.04	0.48	+68.2
Muscidae	Musca sorbens	5.33	+96.8	0.49	+55.55		
	Musca pattoni	-	-	0.10	+75.0		
	Ophyra chalcogauter	-	-	0.65	+72.5		
Sarcophagidae	P(=sarcophaga) brevicornis	0.75	-83.2	0.60	+45.54		
	P(=sarcophaga) ruficornis	0.75	+83.2	0.45	+28.56		
	P(=sarcophaga) peregrina	-	-	0.38	-17.14		

* Results of Siliguri taken from Ray and Dasgupta (1975) and that of Calcutta taken from Das (1980).

Table No. 3. Volume and Relative Size of Synanthropic flies of Jalpaiguri Town.

FAMILY	SPECIES	a	b	c	Volume mm	Relative Size
CALLIPHORIDAE	Chrysomya megacephala	4.0	4.0	10.0	160	3.04
	Chrysomya ruffifacies	3.5	3.5	9.0	110.25	2.1
	Hemipyrellia ligurriens	4.0	4.0	9.0	144.0	2.74
	Hemipyrellia pulchra	3.0	4.0	9.0	108.0	2.1
	Lucilia cuprina	2.5	3.0	8.0	60.0	1.14
MUSCIDAE	Musca domestica	2.5	3.0	7.0	52.5	1.0
	Musca sorbens	2.5	2.5	6.5	40.62	0.8
	Musca lucens	2.0	2.5	6.5	32.5	0.6
	Musca pattoni	3.0	3.0	7.5	67.5	1.28
	Musca ventrosa	2.3	3.0	6.0	41.4	0.78
	Ophyra chalcogaster	2.0	2.5	6.0	30.0	0.6
SARCOPHAGIDAE	Parasarcophaga knabi	3.0	3.5	10.0	105.0	2.0
	Parasarcophaga brevicornis	3.5	4.0	12.3	172.2	3.3
	Parasarcophaga albiceps	2.3	3.0	9.2	63.48	1.2
	Parasarcophaga ruficornis	4.0	5.0	12.5	250.0	4.76
	Parasarcophaga misera	3.5	4.5	12.0	189.0	3.6
	Parasarcophaga orchidea	2.5	3.0	10.0	75.0	1.37
	Boettcherisca peregrina	3.0	4.0	10.0	120.0	2.3

Table No. 4. Danger - indices of Synanthropic flies of Jalpaiguri Town.

Family	Species	D = (a+b+c+d)(e+f+g)m =		
CALLIPHORIDAE	Chrysomya megacephala	D = (0+0+0+0)(1+1+1)	3.04	9.12
	Chrysomya rufifacies	D = (0+0+0+0)(1+1+1)	2.1	6.3
	Hemipyrellia ligurriens	D = (1+1+1+0)(1+1+1)	2.74	24.66
	Hemipyrellia pulchra	D = (1+1+1+0)(1+1+0)	2.1	12.6
	Lucilia cuprina	D = (0+0+0+0)(1+1+1)	1.1	3.1
MUSCIDAE	Musca domestica	D = (0+1+1+1)(1+1+1)	1.0	9.0
	Musca sorbens	D = (0+0+0+0)(1+1+1)	0.8	2.4
	Musca lucens	D = (0+1+1+0)(1+1+1)	0.6	3.6
	Musca pattoni	D = (0+0+0+0)(0+1+1)	1.28	2.56
	Musca ventrosa	D = (0+1+1+0)(0+1+1)	0.78	3.08
	Ophyra chalcogaster	D = (0+0+0+0)(0+1+0)	0.6	0.6
SARCOPHAGIDAE	Parasarcophaga knabi	D = (1+1+1+0)(0+1+1)	2.0	12.0
	Parasarcophaga brevicornis	D = (0+0+0+0)(0+1+0)	3.3	3.3
	Parasarcophaga albiceps	D = (1+1+1+0)(1+1+1)	1.2	10.8
	Parasarcophaga ruficornis	D = (0+0+0+0)(1+1+1)	4.7	14.1
	Parasarcophaga misera	D = (1+1+1+0)(0+1+1)	3.6	21.6
	Parasarcophaga orchidea	D = (1+1+1+0)(0+1+1)	1.37	8.22
	Boettcherisca peregrina	D = (1+1+1+0)(1+1+0)	2.3	13.8

Table No. 5. Percentage of flies of Mohitnagar Village and Dinbazar Food Market corrected by their danger indices.

FAMILY	SPECIES	VILLAGE		FOOD MARKET	
		Percentage.	% x Index.	Percentage.	% x Index.
CALLIPHORID	*Chrysomya megacephala*	83.44	760.97	73.34	668.86
	Chrysomya rufifacies	1.33	5.53	0.91	3.82
	Hemipyrellia ligurriens	0.29	7.75	2.57	63.67
	Hemipyrellia pulchra	0.07	0.8[illegible]	0.36	4.53
	Lucilia cuprina	0.66	2.04		
MUSCID	*Musca domestica*	0.73	6.57	9.37	89.73
	Musca sorbens	1.18	5.66	4.59	22.03
	Musca lucens	3.47	12.49	1.47	5.29
	Musca pattoni	0.07	0.17	0.91	2.32
	Musca ventrosa			0.36	0.92
	Ophyra chalcogaster	2.43	2.91		
SARCOPHAGID	*Parasarcophaga knabi*	0.96	11.52		
	Parasarcophaga brevicornis	1.55	5.11	0.73	2.4
	Parasarcophaga albiceps	1.84	19.97	1.10	11.88
	Parasarcophaga ruficornis	0.8[illegible]	12.4		
	Parasarcophaga misera	0.22	3.16	0.55	7.92
	Parasarcophaga orchidea	0.07	0.57		
	Boettcherisca peregrina	0.4[illegible]	6.0[illegible]		

NOTES AND REFERENCES

APPENDIX - I

Distribution of Calliphorid flies in the Indian Sub-continent as per Seniorwhite *et al*., (1940) and James (1977).

Genus : Species	Locality
Chrysomya megacephala (Fabricius, 1784)	Throughout Oriental region.
Chrysomya rufifacies (Macquart, 1842)	Entire Oriental region.
Hemipyrellia ligurriens (Wiedemann, 1830)	Calcutta, West Bengal; Bihar; Tamil Nadu; Sri Lanka.
Hemipyrellia pulchra (Wiedemann, 1830)	Punjab; Agra; West Bengal; Pondicherry; Bihar; Coimbatore, Madras.
Lucilia ampullacea (Villeneuve, 1922)	Darjeeling, West Bengal; Kerala.
Lucilia papuensis (Macquart, 1842)	Whole of India.
Phaenicia cuprina (Wiedemann, 1830) /=*Lucilia cuprina* (Wiedemann, 1830)/	Throughout India.
Lucilia (=*Phaenicia*) *sericata* (Meigen, 1826)	Punjab and Ambala; Afganistan.

Genus : Species	Locality
Calliphora pattoni (Aubertin, 1931)	Kashmir; Darjeeling, West Bengal; Khasi Hills; Dalai Valley 4000' - 10,000'; Nepal; Burma.

APPENDIX - II

Distribution of Sarcophagid flies in the Indian Sub-continent as per Seniorwhite *et al.*, (1940) and Lopes *et al.*, (1977).

Genus : Species	Locality
Parasarcophaga (*Parasarcophaga*) *knabi* (Parker) (=*Sarcophaga knabi* Parker, 1917)	From the Punjab eastwards throughout India and Andaman Island; Sri Lanka; Burma.
Parasarcophaga (*Liosarcophaga*) *brevicornis* (Ho) (=*Sarcophaga brevicornis* Ho, 1934)	India.
Parasarcophaga (*Liopygia*) *ruficornis* (Fabricius) (=*Musca ruficornis* Fabricius, 1794)	Widely distributed in India, recorded from North-West Frontier Province, Abbotabad, to Madras, Tinnevelly District, Sri Lanka.
Parasarcophaga (*Parasarcophaga*) *albiceps* (Meigen) (=*Sarcophaga albiceps* Meigen, 1826)	Throughout India, including the hills upto 6000 ft; Sri Lanka and Burma.
Parasarcophaga (*Liosarcophaga*) *misera* (Walker) (=*Sarcophaga misera* Walker, 1849)	Kashmir, Nilgiri Hills, India; Dacca, Bangladesh; Sri Lanka

Genus : Species	Locality
Parasarcophaga (Parasarcophaga) orchidea (Böttcher) (=Sarcophaga orchidea Böttcher, 1913)	Occurs generally throughout India.
Parasarcophaga (Parasarcophaga) hirtipes (Wiedemann) (=Sarcophaga hirtipes Wiedemann, 1830)	Ludhiana, Ajmir, Ahmedabad, Dharwar and Coimbatore.
Boettcherisca peregrina (Robineau-Desvoidy) (=Myophora peregrina Robineau-Desvoidy, 1830)	India.
Boreaca haemorrhoidalis (Fallén) (=Musca haemorrhoidalis Fallén, 1816)	India.
Seniorwhitea krameri (Böttcher) (=Sarcophaga krameri Böttcher, 1912)	Assam, India; Sri Lanka.
Harpagophalla kempi (Seniorwhite) (=Sarcophaga kempi Seniorwhite, 1924)	Pusa, Bihar; Calcutta, West Bengal.
Pierretia (Ascogetella) calcifera (Böttcher) (=Sarcophaga calcifera Böttcher, 1912)	Bihar, Pusa; Nilgiris, Coonoor; Sri Lanka.
Sarcosolomonia (Parkerimyia) crinita (Parker) (=Sarcophaga crinita Parker, 1917)	Bihar, Pusa; Chapra; Chota Nagpur; West Bengal, Calcutta; Tamil Nadu Burma.

Genus : Species	Locality
Iranibindia martellata (Seniorwhite) (=Sarcophaga martellata Seniorwhite, 1924)	Madhya Pradesh, Jonk River; Patna, Titlagarh, Chota Nagpur, Dumraon; Calcutta; Tamil Nadu, Parvatipuram, Coimbatore, Calicut, Kallar, Madras; Sri Lanka.

APPENDIX - III

Distribution of Muscid flies in the Indian Sub-continent as per van Emden (1965) and Pont (1977).

Genus : Species	Locality
Musca domestica (Linnaeus, 1758)	Andhra Pradesh; Assam; Bihar; Himachal Pradesh; Kashmir; Tamil Nadu; Punjab; Maharashtra; Karnataka; Goa; Sikkim; Almora, Uttar Pradesh; Darjeeling, West Bengal and Nepal; Burma; Sri Lanka.
Musca (=Byomya) sorbens Wiedemann, 1830)	Andhra Pradesh; Assam; Bihar; Tamil Nadu; Goa; Uttar Pradesh; West Bengal; Nepal; Sri Lanka; Burma; Afganistan.
Musca (=Byomya) conducens Walker [=Musca (Byomya) lucens Villeneuve, 1922]	Andhra Pradesh; Assam; Madhya Pradesh; Orissa; Punjab; Uttar Pradesh; West Bengal; Sri Lanka; North East Burma.
Musca (Byomya) ventrosa Wiedemann, 1830	Andhra Pradesh; Assam; Bihar; Tamil Nadu; Uttar Pradesh; Nepal; Sri Lanka; Burma.

Genus : Species	Locality
Musca (Byomya) pattoni Austen, 1910	Andhra Pradesh; Assam; Bihar; Tamil Nadu; Uttar Pradesh; West Bengal; Nepal; Sri Lanka.
Musca (Byomya) confiscata Speiser /=Musca (Byomya) fasciata Stein, 1910./	Andhra Pradesh; Coimbatore; Jabalpur, Madhya Pradesh; Madras; Agra, Uttar Pradesh; Calcutta, West Bengal; Sri Lanka; Burma.
Musca (Philaematomyia) crassirostris Stein, 1903 (=Musca crassirostris Stein)	Andhra Pradesh; Coimbatore; Gauhati, Assam; Pusa, Bihar; Kerala; Madhya Pradesh; Tamil Nadu; Punjab; Maharashtra; Uttar Pradesh; West Bengal; Sri Lanka; Burma.
Ophyra chalcogaster (Wiedemann, 1824) /=Ophyra nigra (Wiedemann)/	Assam; Himachal Pradesh; Kerala; Tamil Nadu; Maharashtra; Goa; Uttar Pradesh; West Bengal.
Ophyra leucostoma (Wiedemann, 1817)	Kashmir; Dal Lake, Nagin.
Ophyra capensis (Wiedemann, 1818)	Andhra Pradesh; Tamil Nadu; Uttar Pradesh; West Bengal; Sri Lanka.

Genus : Species	Locality
Synthesiomyia nudiseta (vander Wulp, 1883)	Calcutta, West Bengal.
Stomoxis calcitrans (Linnaeus, 1758)	Andhra Pradesh; Assam; Bihar; Kerala; Tamil Nadu; Maharashtra; Goa; Orissa; Sikkim; Uttar Pradesh; West Bengal and in other countries of Oriental region.
Diohaetomyia sp	Available in Oriental region.

APPENDIX - IV

Distribution of Sarcophagid flies in West Bengal state as per Nandi (1977).

Genus : Species	District in which occurs
Bercaea haemorrhoidalis	Jalpaiguri and Darjeeling.
Boettcherisca bengalensis	Midnapore, Bankura and Birbhum.
Boettcherisca perigrina	Calcutta, 24-Parganas, Birbhum, Murshidabad, Malda & Jalpaiguri.
Harpagophalla kempi	Calcutta, Midnapore, Purulia, Bankura, Birbhum & Jalpaiguri.
Iranihindia futilis	Calcutta, Purulia, Malda & Darjeeling.
Iranihindia indica	Midnapore, Birbhum & Malda.
Iranihindia jamesi	Purulia and Birbhum.
Iranihindia martellata	Calcutta, Purulia, Bankura & Birbhum.
Iranihindia martellatoides	Calcutta, Purulia, Bankura & Malda.
Leucomyia cinerea	Midnapore.
Lieproctia midnaporensis	Midnapore.

APPENDIX - IV

Genus : Species	District in which occurs
Parasarcophaga kalimpongensis	Darjeeling.
Parasarcophaga scoparifermis	24-Parganas, Midnapore & Howrah.
Parasarcophaga ruficornis	Calcutta, 24-Parganas, Bankura, & Darjeeling.
Parasarcophaga brevicornis	Calcutta, 24-Parganas, Midnapore, Purulia, Bankura, Hooghly, Howrah, Birbhum, Malda, West Dinajpur, Jalpaiguri & Darjeeling.
Parasarcophaga dux	Calcutta, 24-Parganas, Midnapore, Bankura, Howrah, Birbhum, Murshidabad, Nadia, Coochbehar & Jalpaiguri.
Boettcherisca nathani	Darjeeling.
Parasarcophaga josephi	24-Parganas.
Parasarcophaga albiceps	Calcutta, 24-Parganas, Midnapore, Purulia, Bankura, Hooghly, Burdwan, Birbhum, Murshidabad, Nadia, Cooch-behar, Jalpaiguri & Darjeeling.

Genus : Species	District in which occurs
Paraparcophaga hirtipes	Calcutta, Purulia, Malda & Jalpaiguri.
Paraparcophaga knabi	From all the districts of West Bengal.
Paraparcophaga orchidea	From all the districts of West Bengal except Burdwan & West Dinajpur.
Paraparcophaga bainbriggei	Calcutta, Birbhum & Malda.
Pierretia caligifera	Calcutta & Midnapore.
Robineauella ceci	Darjeeling.
Robineauella hanoi	Darjeeling.
Sarcosolomonia crinita	24-Parganas.
Sarcosolomonia indica	Midnapore.
Sarcosolomonia nathani	Birbhum.
Sarcosolomonia rohdendorfi	24-Parganas.
Seniorwhitea kraemeri	Midnapore, Purulia, Bankura, Howrah, Birbhum, Murshidabad, Nadia & Jalpaiguri.
Seniorwhitea lopesi	Darjeeling.
Sphoniproenia bengalensis	24-Parganas & Purulia.
Thyrsocnema longistylata	Calcutta, 24-Parganas & Midnapore.

Genus : Species	District in which occur
Trichelioprectia flavinervis	Jalpaiguri.
Trichelioprectia pusana	Calcutta & Nadia.
Lioprectia annandalei	Midnapore.
Paragaeophaga dux (harpax)	Nadia.
Paragaeophaga macroauriculata	Darjeeling

APPENDIX - V

Distribution of Sarcophagid flies in Jalpaiguri district as per Nandi (1977).

Genus : Species	Locality
Parasarcophaga brevicornis	Chapramari forest, Gorumara and Madarihat.
Parasarcophaga dux	Chalsa.
Parasarcophaga albiceps	Chapramari forest, Falakata, Gorumara, Jayanti, Madarihat and Rajabhatkawa forest.
Parasarcophaga hirtipes	Chilapata forest.
Parasarcophaga knabi	Chalsa, Chilapata forest, Falakata, Madarihat and Rajabhatkawa forest.
Parasarcophaga orchidea	Chalsa, Chilapata forest, Falakata, Jayanti, Madarihat and Rajabhatkawa.
Seniorwhitea krameri	Chilapata forest, Gorumara, Jayanti and Madarihat.
Boettcherisca peregrina	Chapramari forest and Falakata
Sarcodexia haemorrhoidalis	Chalsa.
Harpagophalla kempi	Gorumara.
Trichelioprosctia flavinervis	Jayanti.

APPENDIX - VI

Meteorological conditions during the study of Diurnal activity of flies of Jalpaiguri Town obtained from Regional Meteorological Station, Alipore, Calcutta.

Date	Dry bulb temp. °C		Humidity %		Wind/km.		Visibility		*Cloud amount		Rainfall.
	8.30 hrs	17.30 hrs	8-30	17-30	8-30	17-30	8-30	17-30	8-30	17-30	
					June 1975						
25.6.75	24.5	30.4	096	075	NE-004	E-004	97	97	8	1	132.0mm
26.6.75	28.9	32.9	081	063	NE-002	C-000	97	97	3	1	001.0mm
27.6.75	25.9	28.8	092	083	NE-002	N-004	97	97	8	7	002.8mm
28.6.75	25.1	29.9	096	078	E-002	SE-004	96	97	8	6	029.2mm
					September 1975						
7.9.75	26.0	26.4	090	092	E-006	E-004	97	97	8	8	020.8mm
11.9.75	27.2	28.4	078	073	SE-006	E-004	97	97	7	5	000.2mm
28.9.75	26.9	29.0	088	074	E-002	C-000	97	96	8	8	015.0mm

*Cloud amount measured in Oktas.

APPENDIX - VII

Meteorological conditions during the experimental period, i.e., January 1974 - December 1974 as per meteorological station "Alipore", Calcutta.

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs. ending 8.30 hrs.
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
			January 1974		
1.1.74	25.1	11.9	079	058	
2.1.74	26.4	09.9	080	068	
3.1.74	25.9	10.0	085	065	
4.1.74	25.4	10.4	092	065	
5.1.74	25.4	10.7	089	059	
6.1.74	24.9	10.6	089	065	
7.1.74	25.4	10.2	092	061	
8.1.74	25.4.	09.9	100	065	
9.1.74	23.6	10.3	095	067	
10.1.74	23.4	09.9	095	075	
11.1.74	23.4	09.9	091	072	
12.1.74	22.9	09.7	100	058	
13.1.74	22.9	08.7	087	072	
14.1.74	22.4	09.4	090	094	

Continued...

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs, ending 8.30 hrs.
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
15.1.74	16.9	11.9	090	074	028.2
16.1.74	20.4	08.2	100	075	
17.1.74	19.2	07.5	094	067	
18.1.74	21.4	08.6	08[illegible]	063	
19.1.74	23.1	07.4	100	060	
20.1.74	22.6	08.9	091	072	
21.1.74	22.4	10.4	091	073	
22.1.74	23.4	10.6	093	069	
23.1.74	23.4	12.4	091	081	
24.1.74	22.4	12.9	090	087	
25.1.74	22.9	11.9	093	069	
26.1.74	22.4	10.9	084	064	
27.1.74	26.4	11.4	089	064	
28.1.74	25.4	14.4	089	062	001.6
29.1.74	25.4	13.9	089	067	
30.1.74	24.4	10.9	080	073	
31.1.74	21.9	09.9	075	059	
MEAN	23.5°C	10.5°C	90%	68.48%	

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs, ending 8.30 hrs.
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
			February 1974		
1.2.74	21.9	10,4	083	072	
2.2.74	22.9	10.9	060	048	
3.2.74	24.4	10.4	083	056	
4.2.74	23.9	10.5	091	067	
5.2.74	24.9	10.4	083	059	
6.2.74	22.4	07.3	074	071	
7.2.74	21.0	07.0	083	055	
8.2.74	21.9	08.6	077	053	
9.2.74	24.9	08.7	083	051	
10.2.74	24.4	05.9	078	055	
11.2.74	23.9	08.8	085	059	
12.2.74	24.4	12.9	081	073	
13.2.74	24.4	10.2	088	055	
14.2.74	26.9	10.00	086	045	
15.2.74	26.9	09.4	077	047	
16.2.74	26.4	09.9	076	052	

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs, ending 8.30 hrs.
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
17.2.74	26.4	12.4	075	046	
18.2.74	27.6	11.8	089	047	
19.2.74	28.2.	14.6	067	051	
20.2.74	26.5	14.9	075	053	
21.2.74	28.1	14.0	081	050	
22.2.74	29.9	14.0	078	054	
23.2.74	29.9	15.7	072	056	
24.2.74	29.9	15.7	073	056	
25.2.74	30.9	13.3	071	052	
26.2.74	28.4	14.5	072	053	
27.2.74	29.9	12.9	065	050	
28.2.74	28.9	12.2	058	039	
MEAN	25.8	11.2			

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs, ending 8.30 hrs.
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
			March 1974		
1.3.74	28.4	12.9	065	049	00.00
2.3.74	29.9	14.4	067	039	
3.3.74	29.9	15.5	063	052	
4.3.74	30.4	17.7	049	053	
5.3.74	26.5	14.7	077	047	
6.3.74	27.9	14.2	069	054	
7.3.74	29.4	14.7	060	048	
8.3.74	29.4	16.7	077	051	
9.3.74	31.0	17.4	075	049	
10.3.74	32.2	18.0	071	049	
11.3.74	31.4	16.0	063	046	
12.3.74	31.9	14.1	066	027	
13.3.74	31.9	12.9	054	049	
14.3.74	28.4	14.7	059	043	
15.3.74	32.1	15.9	062	045	

Continued...

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs, ending 8.30 hrs
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
16.3.74	32.4	15.4	062	042	
17.3.74	30.9	16.0	061	021	
18.3.74	33.9	13.5	036	021	
19.3.74	31.4	12.4	052	015	
20.3.74	31.4	16.4	060	045	
21.3.74	31.0	15.9	059	040	
22.3.74	32.9	15.2	061	049	
23.3.74	30.9	17.4	067	043	
24.3.74	31.9	19.4	089	085	00.00
25.3.74	31.9	16.9	083	083	010.8
26.3.74	24.9	16.2	087	086	002.4
27.3.74	24.4	16.7	080	065	
28.3.74	27.4	16.9	061	057	
29.3.74	28.4	17.9	068	060	
30.3.74	29.9	17.2	097	075	
31.3.74	23.9	16.2	080	064	
MEAN	30.0	15.5	58.483		1.105mm

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs, ending 8.30 hrs
	Maximum	Minimum	At 8.30 hrs	At 17.30 hr	
			April 1974		
1.4.74	29.0	21.4	084	072	0000
2.4.74	26.0	19.4	077	089	000.2
3.4.74	28.9	20.0	091	077	045.4
4.4.74	28.9	21.6	078	074	0000
5.4.74	30.9	18.8	083	070	008.8
6.4.74	28.9	19.4	085	086	0000
7.4.74	30.0	19.0	077	067	011.2
8.4.74	29.4	19.4	069	069	0000
9.4.74	28.9	20.0	067	065	0000
10.4.74	29.4	16.9	075	059	016.8
11.4.74	27.9	18.4	064	063	0000
12.4.74	29.4	17.6	056	054	0000
13.4.74	29.4	19.9	059	049	0000
14.4.74	30.4	20.5	068	047	0000
15.4.74	31.9	20.4	057	043	0000

Continued...

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs, ending 8.30 hrs
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
16.4.74	33.6	22.8	070	047	0000
17.4.74	33.9	21.0	097	089	050.0
18.4.74	22.9	20.6	085	087	039.0
19.4.74	24.9	19.7	077	071	0000
20.4.74	29.9	23.4	081	074	0000
21.4.74	31.9	24.4	081	074	0000
22.4.74	31.4	22.4	093	073	036.8
23.4.74	29.4	22.6	083	081	0000
24.4.74	30.9	23.4	077	079	0000
25.4.74	31.4	23.2	087	076	0000
26.4.74	31.0	23.4	089	072	0000
27.4.74	31.4	22.4	091	071	011.4
28.4.74	30.4	22.9	091	071	0000
29.4.74	30.4	20.8	080	071	021.6
30.4.74	30.9	19.3	086	075	031.6
MEAN	29.9	20.8	74.05		9.06

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs, ending 8.30 hrs
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
			May 1974		
1.5.74	27.4	21.3	087	077	001.2
2.5.74	27.4	19.4	079	083	013.2
3.5.74	26.3	21.9	073	071	0000
4.5.74	29.9	22.2	076	077	0000
5.5.74	29.9	22.4	090	083	010.4
6.5.74	27.4	23.1	087	081	000.8
7.5.74	30.4	23.4	086	076	004.8
8.5.74	30.9	20.9	086	075	041.2
9.5.74	30.4	20.1	094	087	019.4
10.5.74	24.4	19.7	077	079	028.6
11.5.74	25.9	21.2	095	085	005.8
12.5.74	25.4	21.2	095	082	065.8
13.5.74	26.9	20.9	092	073	013.0
14.5.74	27.7	21.3	085	075	000.2
15.5.74	28.2	22.2	085	078	000.8

Continued ...

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs, ending 8.30 hrs
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
16.5.74	29.9	20.2	081	073	048.0
17.5.74	28.4	23.2	081	079	0000
18.5.74	30.4	22.4	080	077	0000
19.5.74	29.4	23.7	078	067	022.6
20.5.74	27.0	19.4	075	067	014.2
21.5.74	29.9	22.4	086	061	0000
22.5.74	29.9	23.4	065	053	0000
23.5.74	31.4	23.4	063	051	
24.5.74	34.6	24.3	059	047	
25.5.74	35.1	24.4	056	051	
26.5.74	35.9	25.4	071	053	
27.5.74	35.4	26.1	068	059	000
28.5.74	34.9	26.0	065	076	
29.5.74	34.4	25.9	087	075	005.8
30.5.74	30.9	24.8	071	081	
31.5.74	34.7	25.5	077	073	001.2
MEAN	30.2	23.1	27.272		9.58

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs. ending 8.30 hrs
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
			June 1974		
1.6.74	32.2	23.3	087	067	012.6
2.6.74	31.4	23.1	097	087	017.0
3.6.74	27.7	23.7	093	081	017.4
4.6.74	31.4	20.9	087	087	009.0
5.6.74	27.4	21.9	087	086	026.0
6.6.74	27.9	22.2	095	080	002.8
7.6.74	27.7	22.2	079	081	0000
8.6.74	31.4	21.4	077	058	013.2
9.6.74	32.9	24.4	078	075	000
10.6.74	34.4	22.9	079	061	012.0
11.6.74	33.4	24.9	073	057	0000
12.6.74	34.4	26.0	073	068	0000
13.6.74	35.6	26.7	077	067	0000
14.6.74	35.4	26.6	073	096	0000
15.6.74	34.7	24.4	069	065	030.0

Continued -

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs. ending 8.30 hrs
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
16.6.74	34.9	27.1	081	085	0000
17.6.74	31.9	24.2	084	075	008.4
18.6.74	30.9	24.2	092	079	004.6
19.6.74	30.4	25.1	097	089	005.4
20.6.74	27.4	25.9	095	091	071.6
21.6.74	25.9	23.4	088	081	006.0
22.6.74	29.4	21.9	093	081	035.0
23.6.74	30.9	23.1	097	079	019.4
24.6.74	29.5	21.5	095	077	035.8
25.6.74	28.9	22.4	081	076	000.4
26.6.74	30.9	22.7	097	078	091.4
27.6.74	30.7	23.7	078	075	0000
28.6.74	33.3	25.4	077	081	0000
29.6.74	32.9	24.0	097	083	031.4
30.6.74	28.9	23.4	097	088	046.8
MEAN	31.2	23.8	81.75		16.56

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs, ending 8.30 hrs
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
			July 1974		
1.7.74	27.4	25.4	097	094	278.0
2.7.74	25.6	22.9	097	097	044.6
3.7.74	25.4	22.6	087	089	027.2
4.7.74	27.4	22.9	098	090	092.0
5.7.74	27.7	23.0	084	083	000.2
6.7.74	31.4	23.9	098	091	136.0
7.7.74	28.4	23.2	092	079	022.2
8.7.74	30.9	24.6	085	072	0000
9.7.74	32.4	25.2	083	082	0000
10.7.74	30.9	24.4	081	076	005.2
11.7.74	31.4	24.6	076	074	001.4
12.7.74	31.9	25.4	085	075	001.4
13.7.74	32.4	24.9	092	081	000.8
14.7.74	31.4	25.4	084	083	005.0

Continued...

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs, ending 8.30 hrs
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
15.7.74	29.9	23.9	096	092	049.6
16.7.74	26.1	23.2	096	089	062.2
17.7.74	30.4	23.9	097	092	081.0
18.7.74	25.9	22.6	093	075	008.2
19.7.74	29.9	23.6	076	077	000.4
20.7.74	32.4	23.9	087	094	054.4
21.7.74	32.0	23.9	083	096	012.4
22.7.74	30.4	23.9	089	081	004.0
23.7.74	30.2	24.4	093	081	0000
24.7.74	30.00	24.7	092	090	026.2
25.7.74	29.9	23.2	097	081	082.6
26.7.74	28.9	23.9	096	079	010.0
27.7.74	30.4	23.6	097	098	072.6
28.7.74	26.4	23.4	098	081	084.8
29.7.74	29.0	23.2	094	096	029.0
30.7.74	27.3	23.3	096	083	057.2
31.7.74	30.9	25.6	098	091	027.4
MEAN	29.5	23.2	88.048		40.45

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs, ending 8.30 hrs
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
			August 1974		
1.8.74	27.0	23.5	092	086	044.2
2.8.74	28.5	23.3	098	089	206.0
3.8.74	28.4	23.4	098	096	099.0
4.8.74	26.9	22.9	095	093	070.2
5.8.74	26.0	23.2	097	093	043.8
6.8.74	26.2	22.8	095	083	012.4
7.8.74	28.4	25.4	087	070	003.0
8.8.74	31.1	24.2	076	069	0000
9.8.74	33.4	25.2	078	079	0000
10.8.74	32.6	25.2	085	069	013.6
11.8.74	32.9	25.4	082	067	0000
12.8.74	34.4	25.7	079	060	001.4
13.8.74	35.4	25.9	080	065	0000
14.8.74	34.9	25.6	080	077	0000
15.8.74	35.4	25.4	069	069	0000

Continued ...

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs. ending 8.30 hrs
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
16.8.74	32.9	25.4	087	071	000
17.8.74	32.4	25.9	075	077	000.4
18.8.74	33.4	26.2	085	098	0000
19.8.74	32.9	24.4	092	076	032.8
20.8.74	31.9	25.7	093	067	019.6
21.8.74	28.0	25.9	092	070	005.6
22.8.74	32.4	24.9	075	082	002.0
23.8.74	32.4	24.4	088	076	059.4
24.8.74	31.5	24.7	091	081	029.4
25.8.74	31.4	24.0	083	085	005.6
26.8.74	31.9	24.9	095	085	024.2
27.8.74	29.9	25.6	088	084	050.8
28.8.74	29.4	25.7	088	082	007.6
29.8.74	30.9	24.9	100	096	005.2
30.8.74	30.9	25.4	097	096	130.4
31.8.74	26.4	25.2	095	091	082.2
MEAN	30.00	24.3	82.693		30.477

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs, ending 8.30 hrs
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
			September 1974		
1.9.74	27.8	23.4	093	091	052.0
2.9.74	31.4	21.4	095	084	016.2
3.9.74	27.4	22.1	095	084	027.6
4.9.74	26.0	22.4	087	074	012.2
5.9.74	30.4	22.6	092	081	009.0
6.9.74	29.9	23.9	095	085	001.6
7.9.74	31.1	24.4	085	069	0000
8.9.74	32.9	24.8	073	092	0000
9.9.74	33.4	22.6	095	075	028.4
10.9.74	29.9	22.9	094	078	046.4
11.9.74	30.4	24.1	088	092	0000
12.9.74	30.4	22.9	095	085	105.8
13.9.74	30.1	23.1	098	093	006.6
14.9.74	26.6	23.9	091	088	0000
15.9.74	29.4	23.7	089	092	016.2

Continued ..

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs. ending 8.30 hrs
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
16.9.74	29.4	22.9	091	079	005.6
17.9.74	28.9	23.9	090	095	000.2
18.9.74	26.0	22.4	100	080	050.0
19.9.74	28.1	22.9	095	082	015.6
20.9.74	31.0	22.3	098	078	058.2
21.9.74	28.9	22.5	093	088	000.4
22.9.74	26.4	22.2	093	077	023.2
23.9.74	29.4	22.0	095	084	096.6
24.9.74	27.5	22.9	077	072	0000
25.9.74	31.4	22.9	095	066	0000
26.9.74	31.9	23.4	078	067	0000
27.9.74	32.9	24.4	075	069	0000
28.9.74	33.4	23.4	067	080	0000
29.9.74	31.4	23.4	092	085	012.0
30.9.74	27.9	23.2	092	900	028.2
MEAN	29.7	23.0	85.68		20.333

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs, ending 8.30 hrs.
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
			October 1974		
1.10.74	24.9	21.4	099	087	074.4
2.10.74	27.1	22.4	096	082	150.6
3.10.74	30.4	23.9	091	078	
4.10.74	31.0	23.9	092	078	009.2
5.10.74	29.4	22.9	083	070	017.0
6.10.74	31.4	23.5	076	085	0000
7.10.74	32.4	23.7	093	075	0000
8.10.74	31.4	22.9	094	067	010.0
9.10.74	32.9	23.5	078	069	0000
10.10.74	32.9	23.9	079	068	0000
11.10.74	33.4	23.9	081	071	0000
12.10.74	33.7	24.2	087	082	0000
13.10.74	29.9	23.5	088	078	001.8
14.10.74	30.4	23.5	075	076	0000
15.10.74	33.4	23.9	082	075	0000

Continued ...

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs. ending 8.30 hrs
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
16.10.74	33.4	23.9	071	075	0000
17.10.74	33.4	22.4	091	085	034.4
18.10.74	29.4	23.5	088	088	041.2
19.10.74	27.4	23.7	087	072	0000
20.10.74	31.9	24.5	085	073	0000
21.10.74	32.4	21.5	081	063	0000
22.10.74	32.4	22.1	079	079	0000
23.10.74	30.9	22.4	091	085	004.2
24.10.74	28.9	21.9	084	080	
25.10.74	27.4	22.4	093	090	
26.10.74	27.9	21.9	091	073	
27.10.74	30.9	22.3	095	073	
28.10.74	30.4	20.0	083	073	
29.10.74	30.4	17.9	080	063	
30.10.74	30.9	18.0	069	063	
31.10.74	30.4	18.1	072	065	
MEAN	30.7	22.5	80.241		11.058

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs. ending 8.30 hrs.
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
			November 1974		
1.11.74	31.3	18.3	075	065	
2.11.74	31.4	18.2	071	061	
3.11.74	31.4	17.6	071	064	
4.11.74	30.9	17.3	067	059	
5.11.74	31.1	17.6	078	061	
6.11.74	30.9	16.4	067	057	
7.11.74	30.9	16.4	063	058	
8.11.74	30.9	15.9	076	052	
9.11.74	30.9	16.7	075	053	
10.11.74	30.4	16.4	074	057	
11.11.74	30.4	17.2	066	065	
12.11.74	30.4	17.4	076	065	
13.11.74	29.9	17.7	072	065	
14.11.74	29.6	17.6	078	069	
15.11.74	28.4	16.6	070	062	

Continued ...

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs, ending 8.30 hrs
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
16.11.74	29.4	15.9	060	060	
17.11.74	29.1	15.3	062	061	
18.11.74	30.2	14.7	069	056	
19.11.74	29.9	15.6	067	055	
20.11.74	30.4	15.1	072	064	
21.11.74	30.1	15.7	075	068	
22.11.74	27.4	14.7	069	061	
23.11.74	28.9	14.9	076	061	
24.11.74	29.4	14.9	077	068	
25.11.74	28.9	15.6	075	067	
26.11.74	28.9	14.9	066	056	
27.11.74	29.6	13.9	067	061	
28.11.74	28.4	13.4	069	069	
29.11.74	28.4	16.9	087	079	000.2
30.11.74	27.9	14.2	088	061	000.0
MEAN	29.8	16.1	66.933		.006

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs, ending 8.30 hrs
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
			December 1974		
1.12.74	26.4	11.9	089	067	
2.12.74	28.9	12.2	085	059	
3.12.74	26.4	11.8	085	059	
4.12.74	26.4	11.4	077	057	
5.12.74	25.4	12.0	084	069	
6.12.74	25.9	13.3	074	047	
7.12.74	24.9	09.1	087	057	
8.12.74	22.4	10.1	091	065	
9.12.74	22.9	11.1	089	082	
10.12.74	20.4	11.3	089	072	
11.12.74	22.4	11.9	077	066	
12.12.74	23.2	11.0	090	066	
13.12.74	23.9	10.2	083	067	
14.12.74	24.4	11.2	087	062	
15.12.74	24.4	11.4	086	069	
16.12.74	24.4	11.8	087	073	

Continued ...

Date	Temperature in °C		Relative Humidity %		Average Rainfall in mm of 24 hrs, ending 8.30 hrs
	Maximum	Minimum	At 8.30 hrs	At 17.30 hrs	
17.12.74	24.9	12.1	084	081	
18.12.74	20.9	12.2	091	069	000.4
19.12.74	24.4	10.0	100	072	000
20.12.74	21.9	10.1	094	061	
21.12.74	23.9	10.4	094	069	
22.12.74	24.4	09.4	091	056	
23.12.74	25.9	09.9	088	065	
24.12.74	24.4	10.4	088	061	
25.12.74	24.9	10.9	087	065	
26.12.74	25.6	10.9	083	068	
27.12.74	25.4	10.2	083	066	
28.12.74	25.5	09.9	085	053	
29.12.74	26.4	10.0	087	061	
30.12.74	26.4	09.7	090	070	
31.12.74	24.4	10.4	087	068	000
MEAN	24.6	10.9	76.096		0.012

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