

ASPECTS OF POPULATION FLUCTUATIONS OF PHLEBOTOMID SANDFLIES
(DIPTERA ; PHLEBOTOMIDAE) IN CALCUTTA AND ENVIRONS

A. N. T. JOSEPH AND T. N. NINAN

Zoological Survey of India, Calcutta

ABSTRACT

Fluctuation of populations of three species of phlebotomid sandflies—*Phlebotomus argentipes* Annandale and Brunetti, *P. papatasi* Scopoli and *Sergentomyia babu* (Annandale) —from four localities in Calcutta and environs has been studied from February 1978 to January 1979 in relation with temperature, rainfall, humidity and wind velocity.

The outbreak of kala-azar in North Bihar emphasised the need for a general survey of phlebotomid sandflies around Calcutta and as such a study of the fluctuation of populations of sandflies was undertaken during 1978-79 since population density is of fundamental importance both in surveillance of the disease and in control. Earlier Napier and Smith (1926) have given an account of the seasonal prevalence of *Phlebotomus argentipes* Annandale and Brunetti for 13 months from Calcutta and environs in their studies on its bionomics. Recently in a similar study Basu and Ghosh (1954, 1955) have recorded the total catch of the same species from Thakurpukur, 24 Parganas, for one year without the detailed break-up. The present study has an added significance in the context that another species of sandfly, *viz.* *Phlebotomus papatasi*, is suspected to be the vector of kala-azar in N. Bihar either alone or side by side with the proven vector *P. argentipes* (Joseph, 1981). A review of the literature reveals that Sinton (1924) was the first to publish a general idea of the seasonal prevalence of the then known

Indian and Cingalese species of the genus *Phlebotomus*, but without the details of the data of collection. Subsequently Dhanda and Modi (1971) and Modi *et al.*, (1978) have conducted detailed studies in Western India, and Joseph (1981) in North Bihar. The recent study by Joseph is the first of its type in India—the study of vectors while the disease is in prevalence.

MATERIAL AND METHODS

Preliminary surveys were undertaken towards the later half of 1977 in Calcutta and environs—Central Calcutta, Ballygunge, Belgachia Veterinary College, Eden Gardens and Alipur Agrihorticultural Garden (Calcutta), Botanical Garden, Mourigram and Andul (Howrah District), and Behala, Thakurpukur, Kavarapukur, Narendrapur, Lohati and Sonarpur (24 Parganas)—in houses, cattle sheds, tree holes and rat burrows. Finally four localities (Map), *viz.* Eden Gardens, Kavarapukur, Andul and Lohati, were selected for regular periodical surveys. Collections were made with an improvised bait trap (Joseph and

TABLE 1. Phlebotomid sandflies collected per manhour from the holes of a tree in the Eden Gardens, Calcutta, from Feb. 1978 to Jan, 1979 along with meteorological data, two collections per month.

Sp.	Coll.	Feb.'78			Mar.			Apr.			May			June			July			Aug.			Sep.			Oct.			Nov.			Dec.			Jan.'79			Total of the year			% of the Grand Total	
		M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T		
<i>Sergentomyia babu</i>	1st Coll.	30	10	40	9	16	25	16	7	23	12	2	14	19	4	23	34	14	48	18	13	31	9	4	13	9	5	14	7	3	10	8	2	10	5	1	6	176	81	257	69.83	30.17
	2nd ,,	28	7	35	18	9	27	13	5	18	12	8	20	30	11	41	40	18	58	10	4	14	7	3	10	8	5	13	6	2	8	7	2	9	13	4	17	192	78	270		
Grand Total		58	17	75	27	25	52	29	12	41	24	10	34	49	15	64	74	32	106	28	17	45	16	7	23	17	10	27	13	5	18	15	4	19	18	5	23	368	159	527		
Temp. °C Mean. max		28.5			32.7			35.5			35.4			33.8			32.3			31.9			31.3			32.2			27.0			27.6			27.6							
Mean. min		16.5			20.7			23.0			25.7			26.4			25.5			26.2			25.4			20.7			14.5			14.7			14.7							
Rainfall Mean monthly mm.		9.0			57.9			55.4			194.0			224.2			439.2			312.4			944.7			147.7			40.5			3.9			34.9							
Humidity %																																										
Mean max. monthly		90.3			92.7			93.3			87.9			92.7			94.6			95.9			96.8			97.4			95.5			94.9			96.3							
Mean min. ,,		36.4			33.0			43.6			56.0			64.0			65.0			71.0			71.2			60.8			40.7			38.0			40.7							
Wind velocity-Kmph		16.2			18.7			20.8			24.0			22.9			19.8			17.8			17.4			15.6			13.9			14.7			13.0							

M= male, F=female, T=total

TABLE 2. Phlebotomid sandflies collected per manhour from a cattle shed in Andul in Howrah Dist. from Feb. 1978 to Jan. 1979 (meteorological data as in Table. 1), two collections per month.

Spp.	Coll.	Feb.'78			Mar.			Apr.			May			June			July			Aug.			Sept.			Oct.			Nov.			Dec.			Jan.'79			Total of the year			% of the Grand Total	
		M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F
<i>Phlebotomus argentipes</i>	1st Coll.	3	12	15	7	18	25	2	14	16	11	20	31	16	71	87	12	48	60	20	82	102	12	66	78	7	34	41	3	24	27	3	9	12	4	9	13	100	307	407	13.88	43.95
	2nd ,,	11	20	31	2	7	9	4	16	20	6	15	21	15	65	80	20	44	64	18	57	75	10	62	72	5	30	35	2	8	10	8	10	18	2	12	14	103	336	439		
<i>Sergentomyia babu</i>	1st Coll.	14	10	24	16	12	28	16	7	23	10	9	19	31	31	62	20	18	38	10	12	22	10	5	15	8	4	12	6	3	9	8	2	10	4	1	5	153	114	267	23.10	19.07
	2nd ,,	16	11	27	11	25	36	13	5	18	12	8	20	35	40	75	36	41	77	26	18	44	8	4	12	7	4	11	5	2	7	6	3	9	10	4	14	185	165	350		
Grand Total		44	53	97	36	62	98	35	42	77	39	52	91	97	207	304	88	151	23	74	169	243	40	137	177	27	72	99	16	37	53	25	24	49	20	26	46	541	922	1463		

TABLE 3. Phlebotomid sandflies collected per manhour from houses and cattle sheds in Kavrapukur of 24 Pgs. from Feb. 1978 to Jan. 1979 (meteorological data as in Table 1), two collections per month.

Spp.	Coll.	Feb.'78			Mar.			Apr.			May			June			July			Aug.			Sept.			Oct.			Nov.			Dec.			Jan.'79			Total of the year			% of the Grand Total		
		M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F							
<i>Phlebotomus</i>																																											
<i>argentipes</i>	1st. Coll.	2	8	10	1	6	7	2	6	8	—	6	6	2	16	18	6	36	42	8	80	88	6	66	72	8	44	52	6	36	42	3	24	27	—	8	8	91	699	790	7%	52%	
	2nd „	1	8	9	1	9	10	2	8	10	—	6	6	2	20	23	14	84	98	12	84	96	4	52	56	4	40	44	3	18	21	4	24	28	—	10	10						
<i>Sergentomyia</i>																																											
<i>babu</i>	1st Coll	15	20	35	15	16	31	8	11	19	20	19	39	9	13	22	9	4	13	6	4	10	19	16	35	21	13	34	14	6	20	10	4	14	5	3	8	294	253	547	21%	20%	
	2nd „	13	18	31	11	12	23	16	18	34	14	12	26	17	11	28	5	2	7	12	14	26	12	17	29	16	10	26	12	2	14	8	6	14	7	2	9						
Grand Total		31	54	85	28	43	71	28	43	71	34	43	77	30	60	90	34	126	160	38	182	220	41	151	192	49	107	156	35	62	97	25	58	83	12	23	35	385	952	1337			

TABLE 4. Phlebotomid sandflies collected per manhour from houses and cattle sheds in Lo-hati of 24 Pgs. from Feb '78 to Jan.'79 (meteorological data as in Table 1), two collections per month.

Spp.	Coll.	Feb.'78			Mar.			Apr.			May			June			July			Aug.			Sept.			Oct.			Nov.			Dec.			Jan.'79			Total of the year			% of the Grand Total	
		M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F						
<i>Phlebotomus</i>																																										
<i>argentipes</i>	1st. Coll.	2	4	6	3	4	7	1	5	6	2	8	10	2	10	12	10	18	23	18	30	48	10	28	38	16	19	35	8	14	22	3	7	10	1	3	4	76	157	233	15.4	32.32
	2nd „	2	3	5	2	5	7	2	7	9	6	8	14	4	6	10	9	16	25	10	35	45	12	25	37	11	15	26	6	10	16	2	6	8	—	5	5	66	141	207		
<i>Phlebotomus</i>																																										
<i>papatasi</i>	1st „	—	—	—	2	5	7	1	2	3	2	1	3	—	3	3	3	6	9	3	7	10	—	3	3	—	2	2	—	1	1	—	—	—	—	—	—	11	30	41	2.39	7.38
	2nd „	—	2	2	3	7	10	—	2	2	1	1	2	1	4	5	5	13	18	1	4	5	—	4	4	—	1	1	—	—	—	—	—	—	—	—	—	11	38	49		
<i>Sergentomyia</i>																																										
<i>babu</i>	1st „	12	4	16	7	10	17	9	18	27	9	10	19	7	10	17	26	18	44	7	8	15	4	3	7	5	4	9	6	3	9	8	2	10	7	2	9	107	92	199	25.16	17.35
	2nd „	16	5	21	12	5	17	10	3	13	16	14	30	9	2	11	22	17	39	8	5	13	5	3	8	5	4	10	8	4	12	6	3	9	7	3	10	125	68	193		
Grand Total		32	18	50	29	36	65	23	37	60	36	42	78	23	35	58	75	88	163	47	89	136	31	66	97	38	45	83	28	32	60	19	18	37	15	13	28	396	526	922		

Ninan, 1980) with different baits and aspirators. Since the collection was easier by the aspirator, the former method of collection was discontinued.

Regular fortnightly collections were made per manhour during day time by aspirator tube from Eden Gardens (tree holes), Kavara-

two flies. This tree harbours squirrels and their droppings are found on the soil near the tree trunk which is a good medium for larval life. For identification of flies, they were cleared in lacto-chloro-phenol and mounted in gum-chloral medium (Lewis, 1967).

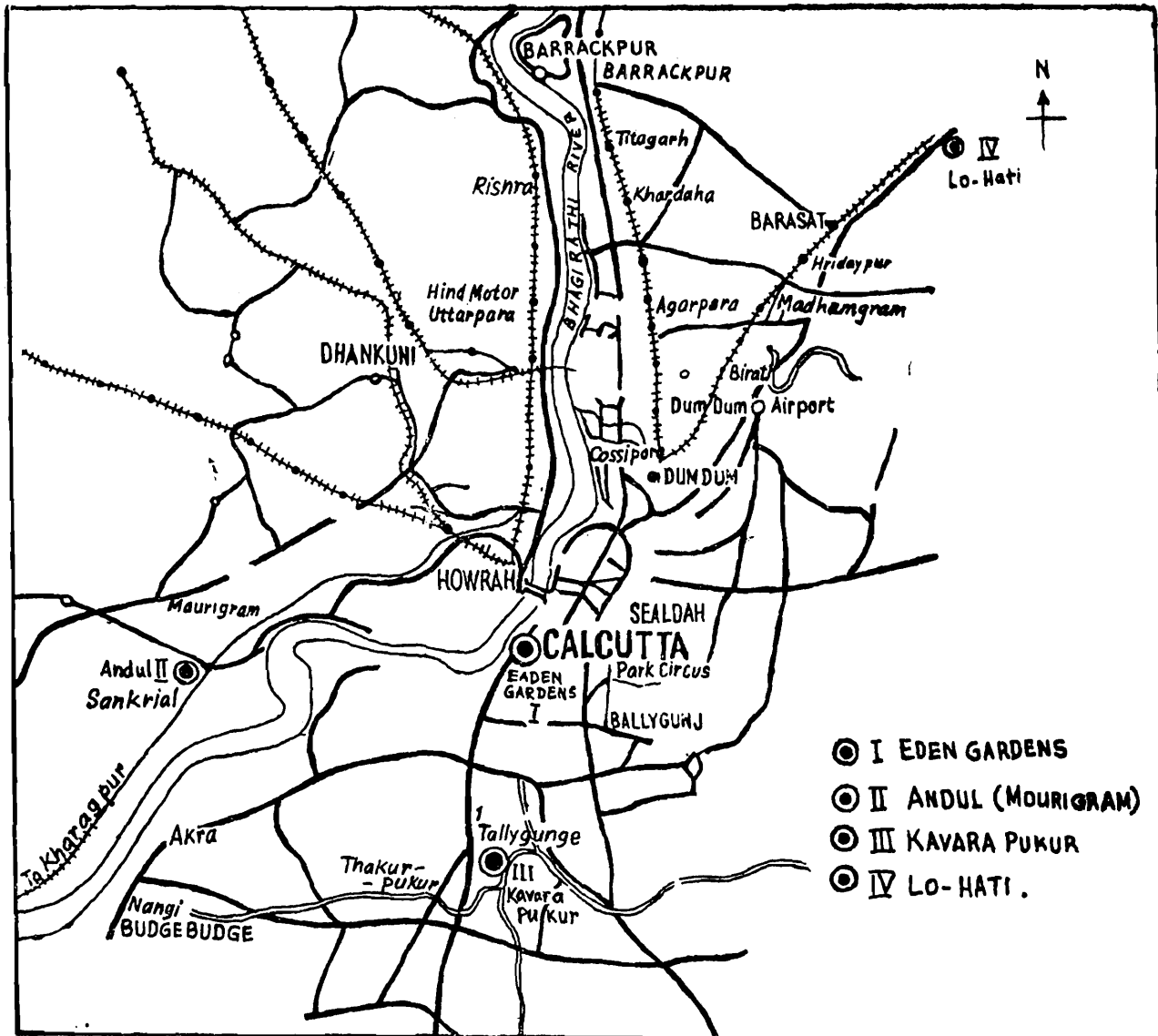


Fig. 1. Map of Calcutta and environs showing collection localities.

pukur and Lo-hati (houses and cattle sheds) and Andul (a cattle shed) for one year from February 1978 to January 1979. In Eden Gardens the flies were collected from the holes of a single tree, *Saraca asoca*, but the adjoining trees yielded none or only one or

RESULTS

A total of 4249 sandflies were collected belonging to *Phlebotomus argentipes* Annandale and Brunetti, *P. papatasi* Scopoli and *Sergentomyia babu* (Annandale) from 4 localities in and around Calcutta as given in tables

1-4. In the collections made from houses and cattle sheds in Lo-hati and Kavrapukur and from a cattle shed in Andul, the predominant species is *Phlebotomus argentipes*. In Lo-hati *Sergentomyia babu* is the next dominant species followed by *Phlebotomus papatasi* whereas in Kavrapukur and Andul the only other species available is *Sergentomyia babu*. In Eden Gardens where the collections were made from the holes of the single tree yielded only *S. babu*. In case of *S. babu* males are always caught in larger number whereas in the remaining 2 species it is vice versa.

Relationship between sandfly population and meteorological factors : Data pertaining to meteorological factors (temperature, humidity and wind velocity) and population density of sandflies were subjected to statistical analysis for finding out correlation coefficient (r) (table 5). It has been found that among the four collection localities, three, i. e., Andul, Kavrapukur and Lo-hati, showed positive correlation between sandfly population and meteorological factors and in some cases it is highly significant.

SEASONAL ABUNDANCE

The incidence of sandfly is low during winter and summer months, especially so in winter and only a few flies could be collected in December and January but in Eden Gardens the lowest catch is made in November. This exception is difficult to explain ; probably it may be due to the excessive feeding by the predator like *Hemidactylus brooki* Gray occurring in the tree. Their peak season is from the later half of June or beginning of July to September, but in case of *Sergentomyia babu* occurring in the single tree, *Saraca asoca*, in Eden Gardens there is a second peak during February-March. As can be seen

from the tables 1-4, the number of flies collected per manhour varies from 6 in January to 58 in July in outdoor and 13 in January to 155 in June in indoor.

DISCUSSION

The pattern of seasonal abundance of *P. argentipes*, *P. papatasi* and *S. babu* in Calcutta and environs is generally similar to that reported from Peninsular India by Mitra (1956) in Poona District, Dhanda and Modi (1971) in Aurangabad district and Modi *et al.*, (1978) in Poona. In Calcutta as well as in Peninsular India the winter is mild and consequently there is a decrease in population of sandflies but they are not totally absent. In places where the winter is severe the flies disappear in extreme cold months and begin to appear in March and showing a peak in monsoon months as has been observed by Sinton (1924) in N. W. Province (Pakistan). George (1970) has also recorded from Peshwar and Lahore areas in Pakistan a similar pattern. In their studies on bionomics of *Phlebotomus argentipes* from Calcutta and environs Napier and Smith (1926) have recorded a similar pattern of prevalence as observed by us. The slight variations exhibited may be due to the climatological differences.

From table 5 it can be observed that the temperature, humidity and wind velocity have significant effect on the fluctuation of population of sandflies, and especially humidity has greater significance. It is possible that the insignificant correlation between the population and factors in Eden Gardens may be due to the small number of flies occurring in the tree.

SOME OBSERVATIONS

The sandflies are normally restricted to the ground floor of houses but a few have

also been found in the first floor as well. They are found in larger numbers in dark corners of the rooms, behind the hanging photographs, calendars, etc. and favour holes or shelves in the walls, when present. Usually they are scarce in kitchen, but on a few occasions we have come across some flies even when the food was being cooked. *Phlebotomus argentipes* are seen in large numbers in cattle sheds whereas *P. papatasi* in living rooms. But during the peak season the two species are also found to occur in both the habitats. *Phlebotomus argentipes* also favour small holes in cattle sheds. *Sergentomyia babu* are generally seen in large numbers in bathrooms and latrines in comparison with the other rooms of the houses, and in tree holes where the other two species are comparatively rare. Bats have been noted in tree holes inhabited by these flies and *Hemidactylus brooki* have been observed predated on

tomya babu were caught. Rodent burrows located in the city and outskirts also did not yield flies. Sinton (1924) had collected *Phlebotomus argentipes* from a tree in Zoo Gardens but not a single fly was observed by us.

It has been our experience that immediately after the rains the collection of sandflies is fairly good but a few days later there is a drop in their number. This may be due to the congregation of flies indoors during the rains and the subsequent decrease can be attributed to the destruction of larvae and pupae due to rains.

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TABLE 5. Showing correlation coefficient values (r) of the sandfly populations against climatological factors

Climatological factors	Eden Gardens		Andul		Kavarapukur		Lo-hati	
	<i>S. babu</i>	<i>P. argentipes</i>	<i>S. babu</i>	<i>P. argentipes</i>	<i>S. babu</i>	<i>P. argentipes</i>	<i>S. babu</i>	
Temperature	0.9376	0.5685**	0.5781**	0.2704	0.4145	0.4142	0.4850	
Humidity	0.0585	0.9652*	0.3696	0.9725*	0.0080	0.9711*	0.1938	
Wind velocity	0.4278	0.4829	0.6471**	0.1170	0.4427	0.0162	0.5564**	

* Significant at 1% level

**Significant at 5% level

S. babu in the holes of *Saraca asoca* in Eden Gardens from which these flies have been regularly collected.

In spite of thorough search in various parts of Calcutta city in houses and cattle sheds not a single fly was caught except from a small shed on the bank of Dhakuria Lake used by the Rowing Club and a few adjoining trees where from a fairly good number of *Sergen-*

our colleague, for statistical analysis of the results.

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