

PRELIMINARY REPORT ON A RAT-FLEA SURVEY OF THE CITY OF SAN JUAN, PORTO RICO.

SECOND PAPER.

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In the issue of this Review for October 1927, a report was given of the work accomplished during the first year of a rat-flea survey which was begun in the City of San Juan by the Plague Prevention Laboratories of our Insular Health Department with the cooperation of the U. S. Public Health Service. The purpose of the present report is to present the data gathered during the second year of the survey (July 1, 1927 to June 30, 1928).

The methods used have been practically the same as those described in the first report. Cage traps have been set in an average of forty-two localities (premises of residences, warehouses, etc.) every day at the rate of about six traps to each locality making a total distribution of 252 traps per day. Rats have been caught in only 1.9 per cent of the localities. It has been estimated that an average of 4.2 animals were captured per thousand traps distributed.

It will be seen that, although trapping has been more active than in the preceding year (148 traps per day), the rodent population appears to have been reduced considerably since last year when we obtained 6.9 rats per thousand traps set.

During the year 396 live rats were trapped: 325 adults, 25 partially grown, and 46 young. There were 135 males and 261 females, 82 of which, 31.4 per cent, were found pregnant with an average of 8.4 embryos each. The highest number of embryos found in any one rat was eleven. It is interesting to remark that the percentage of pregnant females has been almost the same as that of last year although the average number of embryos per pregnant rat has been somewhat higher.

The highest number of rodents was obtained from zone No. 4 (residential). Zone No. 1 (docks) yielded almost as many, while zones Nos. 2 and 3 followed in succession with smaller numbers (See chart No. 1).

Table No. 1 has been prepared to demonstrate the proportional concentration of the species in the various zones.

CHART 1.

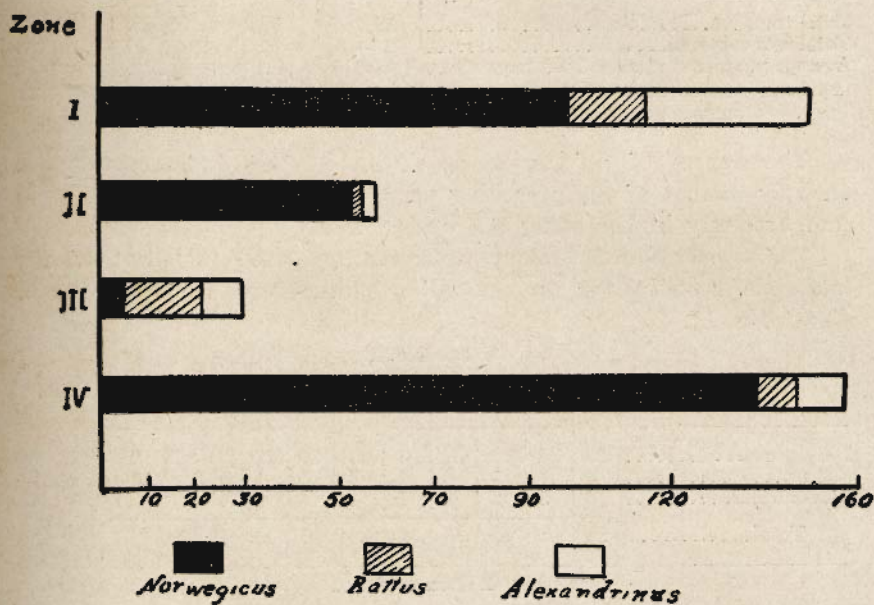


CHART 2

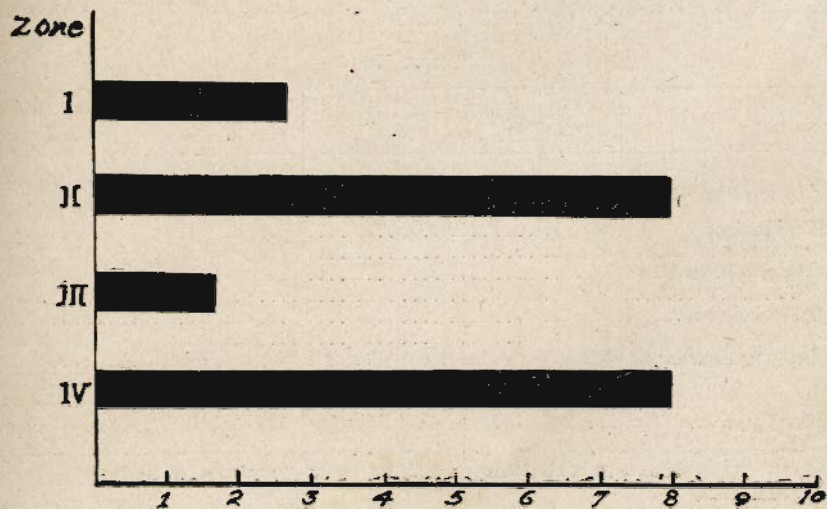


TABLE No. 1*

Zones	1	2	3	4
Total traps set.....	35,656	5,660	15,500	13,325
Total rats captured.....	104	47	28	109
Average number of rats per 1000 traps set ..	2.916	8.303	1.806	8.18

Comparative Concentration of the Species in Different Zones

The degree of infestation as shown by this table corresponds entirely to that of the preceding year, the number of rodents being comparatively higher along the water front.

The *Norwegian* rat alone, representing 74.49 per cent of the total, has been by far the prevailing species (see Table No. 2 and Chart No. 1).

TABLE No. 2

Species	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	Total
<i>Decumanus</i>	22	35	32	27	23	20	18	12	34	19	17	37	296
<i>Rattus</i>	4	1	1	6	5	5	3	1	4	4	10	1	45
<i>Alexandrinus</i>	6	5	2	3	7	1	4	3	11	6	4	3	55
Total.....	32	41	35	36	35	26	25	16	49	29	31	41	396

Monthly Classification of Rats

About 53 per cent of the rats captured during this period harbored fleas. Altogether 2,600 fleas were collected, 1,486 males and 1,114 females, or a ratio of about 1.3 to 1.

The following table shows numbers of the different species of fleas caught in the different months.

TABLE No. 3

Species	Sex	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	Total
<i>Xenopsylla choeipis</i> ..	M	113	124	51	206	120	206	92	71	251	72	100	78	1,484
	F	104	66	41	131	76	102	92	37	240	44	105	54	1,092
<i>Echidnofaga gallinacea</i>	M							1						1
	F							5	1	9		1	2	18
<i>Ctenocephalus C. or F.</i>	M								1					1
	F										1			1
<i>Pulex irritans</i>	M													0
	F											2		2
<i>Leptopsylla musculi</i> .	M													0
	F								1					1
Total.....		217	190	92	337	196	308	190	111	500	117	208	134	2,600

Monthly Tabulation of Fleas as to Species and Sex

* The records for this table do not cover the first three months of the fiscal year.

As was expected from our previous observations, practically all of the fleas collected belonged to the species *X. cheopis* which represented 99.5 per cent of the total number. It is, however, interesting to note the presence this year of the two new species, *Pulex irritans*, and *Leptopsylla musculi*.

The discovery of a specimen of the latter species (*L. Musculi*) has been somewhat of a puzzle to us. Ever since the survey was begun we had been finding occasional specimens of the two species *Echidnofaga gallinacea* and *Ctenocephalus canis* or *felis*. Indeed we expected to find some day specimens of human fleas, for this species is quite common in San Juan. But it was rather remarkable that we should find this single specimen of *Leptopsylla musculi* after a period of two years of observation in which not less than 5,175 fleas were encountered and classified.

There is every reason to believe that this particular flea was brought to our laboratory among a number of dead rats collected after a fumigation of the steamer "Clare" which makes regular trips to New York, occasionally visiting New Orleans. The dead rats arrived so late in the afternoon that the janitor placed them on one of the tables to be examined the following morning. It so happened that a live rat brought in by one of the trappers had been left for some time on that very table, offering an opportunity for parasites infesting the dead animals to jump upon the new host.

The flea index for the year was 6.6. As almost all the fleas were classified as *Xenopsylla cheopis*, the *cheopis* index may be represented by practically the same figure. This is slightly lower than last year. The highest number of fleas found on any one rat was on a female adult, "*Mus alexandrinus*", trapped in one of the docks (Nitrate Agencies). There were 303 fleas on this single rat. The highest number found in a single rat last year was 124. This rat was also caught in zone No. 1.

The following table shows the prevalence of fleas by months:

TABLE No. 4

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	For the year
Percentage of rats with fleas.....	59.4	34.1	137.1	63.9	57.1	61.5	60.0	68.7	49.1	51.7	67.7	46.4	53.0
Average number of fleas per rat.....	6.8	4.6	2.6	9.4	5.6	11.8	7.6	6.9	10.2	4.0	6.7	3.3	6.57

Flea Index of City for the Year 1927-1928

CHART 3

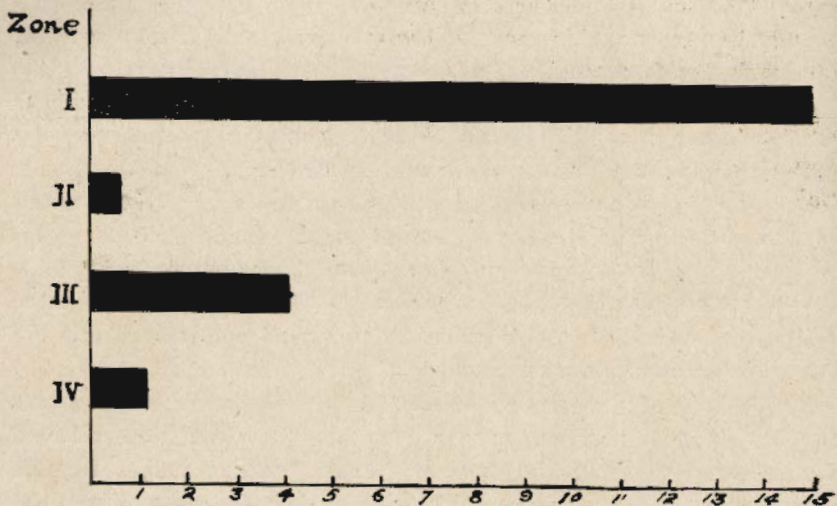
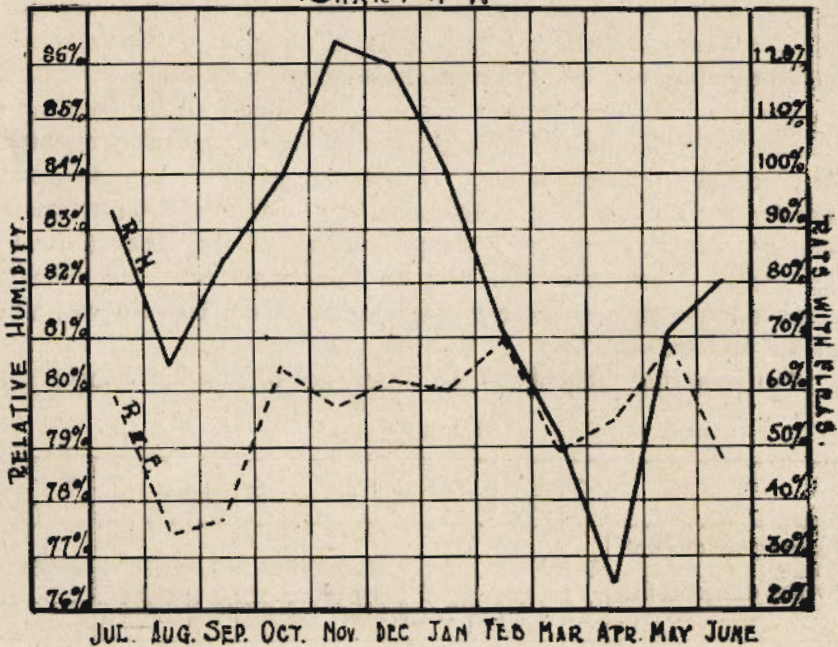


CHART N° IV



The lowest figures were obtained in September 1927 and in June 1928,—2.6 and 3.3 respectively. The highest were found in December 1927 and in March 1928,—11.8 and 10.2 respectively. It will be noticed that, excepting for the months of September and June, the index was never lower than 4. This corresponds quite closely with the results of last year.

Of the 2,600 fleas gathered, zone No. 1 (docks) furnished 2,258; next came the residential area (zone No. 4) with 189; then zone No. 3 (commercial) yielding 121, and, last of all, the water front with only 32 of the insects.

A better idea as to the comparative concentration of rat fleas in the various zones may be gained by calculating the index for each zone considered separately. The figures are given in the following table:

TABLE No. 5

	Zone 1	Zone 2	Zone 3	Zone 4
Percentage of rats with fleas.....	89.4	22.4	79.3	24.7
Average number of fleas per rat.....	15	0.55	4.17	1.2

Comparative Flea Infestation in Different Zones

It is evident from the above table that the water front district as a whole, including zones 1 and 2, are far more heavily infested than the rest of the city, a fact which again confirms our previous experience.

Table No. 6 has been prepared with a view to comparing the degree of flea infestation among the three species of rats.

TABLE No. 6

	Decu- manus	Rattus	Alexan- drinus	Total
Total rats captured.....	296	45	55	396
Total fleas in each species.....	1548	320	732	2600
Percentage of rats having fleas.....	42.9	9.1	76.4	53
Average number of fleas per rat.....	5.2	7.1	13.3	6.6
Average number of fleas per rat last year.....	7.3	8.6	4.0	7.2

Flea Infestation among Various Species of Rats

The results obtained are so at variance with the records of last year that no definite conclusion can be reached as to any predilection on the part of fleas for any particular species of rat. We may learn something more regarding this relationship from further and more extensive observations.

CHART N° V.

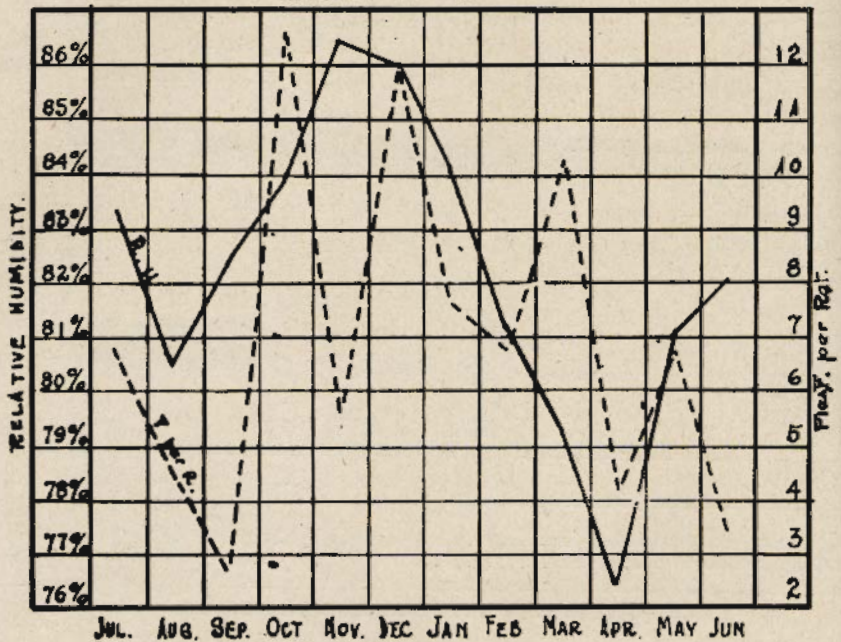
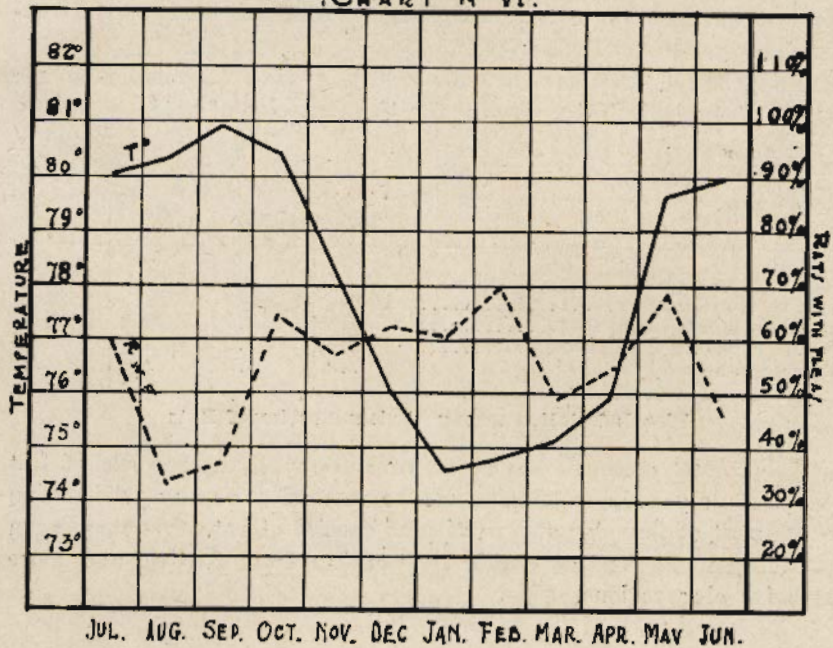


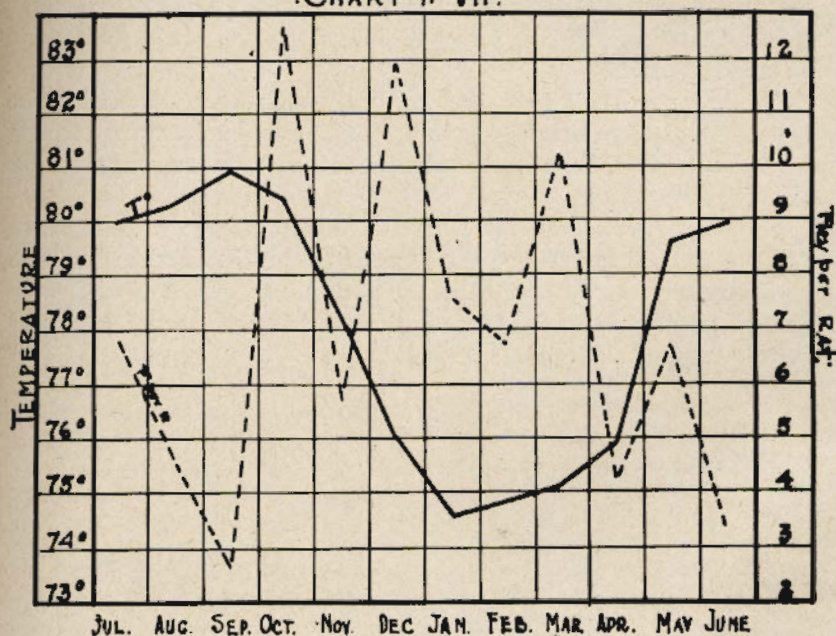
CHART N° VI.



Curves showing the relation of flea prevalence to atmospheric humidity are given in charts Nos. 4 and 5. Here again it is interesting to note the striking way in which the flea lines follow the variations in relative humidity, the fleas increasing or diminishing with the rise and fall of the humidity curve. This is just what would be expected, not only from our experience of last year, but also from that of many other investigators in India and elsewhere.

The flea incidence does not show the same parallelism with temperature changes; that is, the flea curve does not follow the temperature curve to any great extent (see charts Nos. 6 and 7). This

.CHART N°VII.



observation is not in accordance with the data for last year which seemed to show a tendency on the part of the fleas to become more numerous during the warmer months. In fact, the results for this year suggest just the opposite tendency. It becomes evident, therefore, that the relatively small changes in our narrow temperature range do not seem to affect flea breeding to any considerable extent.

SUMMARY

During the year ending June 30th 1928, 396 live rats were captured. Concentration appears to have been greater along the water

front and residential areas of the town and not so heavy at the docks and commercial district. The species *Mus norwegicus* has far outnumbered the other two species.

Among the rodents collected there were 210, or 53 per cent which harbored fleas. A total of 2,600 fleas were classified. Practically all of them were *Xenopsylla cheopis* (99.5 per cent). A few specimens of the following species were found: *Xenopsylla cheopis*, *Echidnophaga gallinacea*, *Ctenocephalus canis* or *felis*, *Pulex irritans* and *Leptopsylla musculi*.

The *flea index* and the *cheopis index* for the year might be represented by practically the same number, 6.6. Concentration of the insects appeared to be decidedly greater about the docks and in the commercial section of the city, and low at the water-front and residential districts.

The seasonal variations in the flea index has followed quite closely the relative humidity curve, while the temperature changes did not seem to influence the number of fleas in any appreciable way.

Mus alexandrinus has revealed the highest degree of infestation for the year. Although the data reported in this article confirms in almost every respect our observations of last year it would seem advisable not to draw final conclusions until the survey has been definitely completed in June 1929.