THE *CULICOIDES* OF THE INTERNATIONAL AIRPORT, ISLA VERDE, PUERTO RICO, AS SHOWN BY LIGHT TRAPS[1]

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The Puerto Rico International Airport is in a region of great natural beauty which includes popular centers, hotels and restaurants, and undeveloped areas where a number of other recreational projects are planned. Many acres of swamps occur in the vicinity with extensive breeding of *Culicoides*, and tourists often suffer severe reactions from the bites of *furens*, the most important pest species (Arèan and Fox, 1955; Fox and Berman, 1960). Except for occasional use of thermal aerosols and DDT residual spraying of buildings, no control measures are applied. Very little money is available for the exclusive study of the problem; however, through the combined efforts of several interested agencies, including the U. S. Public Health Service, Puerto Rico Department of Health and the Puerto Rico Ports Authority, it has been possible to operate several light traps for five years. Our objectives were as follows: To find out what species occur and their relative abundance; to ascertain the seasonal variation of *furens* and relate it to climatic conditions; and to obtain population data for gauging the effectiveness of any future control measures.

The light traps were operated from January 1, 1956 through December 31, 1960 in eight localities (Fig. 2), of which six were the same as in a previous report, on mosquitoes (Fox, 1958). However, in 1958 the Lt. 5 locality (Water Tank, Airport proper) and the Lt. 2 locality (Maintenance Area) were eliminated and other places selected, namely, Lt. 7, designated National Guard, being in the Air National Guard area; and Lt. 8, designated New Maintenance for it was not far from the former locality. The numbers of trap nights during each month in 1956 and 1957 were the same as previously published (Fox, 1958). In 1958, 1959 and 1960 there were comparable figures for the operation. In a total of 7,672 trap-nights five of the nine species known from Puerto Rico (Fox, 1955) were attracted to the traps, and of the total of 499,986 specimens, about 90 percent or 448,547 were *C. furens* (Poey). Next in order of abundance were *insignis* Lutz with 44,169 specimens, *pusillus* Lutz with 6,345, *foxi* Ortiz with 781 and *phlebotomus* (Williston) with only 144. Both 1955 and 1956 were years of heavy tropical storms nine of which reached hurricane intensity in 1955 and three in 1956, with accompanying heavy rainfall and tidal disturbances. These climatic phenomena seemed to have affected *Culicoides* production making 1956 by far the year of greatest *furens* abundance with almost half the total number collected during the five year period even though there were fewest trap-nights. The relative abundance of the four most common species was the same each year as shown in Figure 1. Clearly there was no relationship between the total number of specimens of *furens* collected in all light traps and the total number of inches of rainfall annually; thus, more specimens were collected in 1957 with only 53.01 inches of rainfall than in 1958 with 74.08 inches or 1960 with 64.37 inches. However, *insignis* did show a tendency on an annual basis to increase or decrease in abundance with the total yearly rainfall. When the yearly average per trap-night of three light traps, Lt. 1, Lt. 3, and Lt. 4 which were operated for

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the entire five years, are compared with the annual rainfall, *furens* again shows no relationship and *insignis* indicates some relationship (Fig. 3). Not one of the light traps when considered separately showed any connection between the yearly average per trap-night of *furens* and the annual rainfall (Table 1).

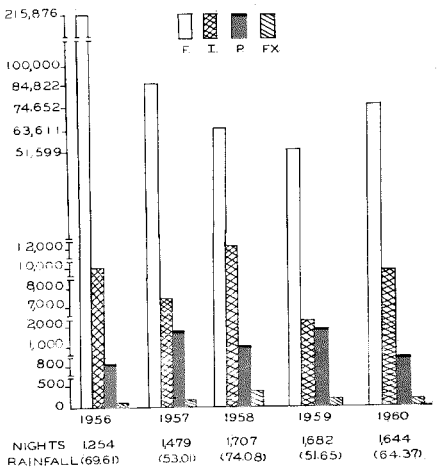

FIG. 1.—The relative abundance of *Culicoides furens, insignis, pusillus,* and *foxi* as shown by the total number of specimens from all light traps 1956–1960, with the trap-nights and rainfall in inches for each year.

The monthly averages per trap-night of all the light traps together indicated that the period of greatest abundance of *furens* is in general from February through June, but in the unusual year 1956 this period extended through October. In the season of greatest abundance, the total monthly average per trap-night was usually between 75 and 100, while in the season of least abundance such as November, December, and January it was about 25 or less. The months with an average of about 50 per trap-night were as follows: In 1956, February through October; 1957, March through June, and also September; 1958, March through June; 1959, June only; 1960, April through June and also September. No relationship to the monthly rainfall in inches could be found, for example in April, 1956 the average per trap-night of five light traps was 758.5 and the April rainfall 4.54 inches, but in May the average was 73.2 and the rainfall was 9.66 inches. In 1957 the peaks of *furens* abundance

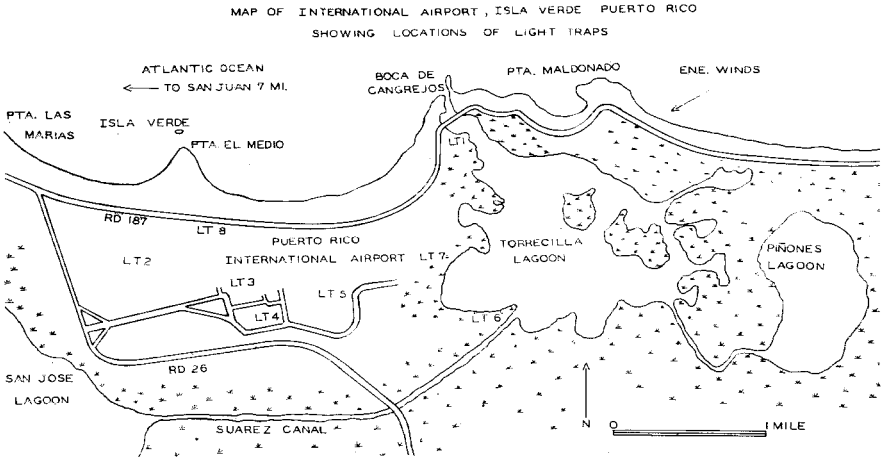

FIG. 2.—Map indicating the location of each light trap.

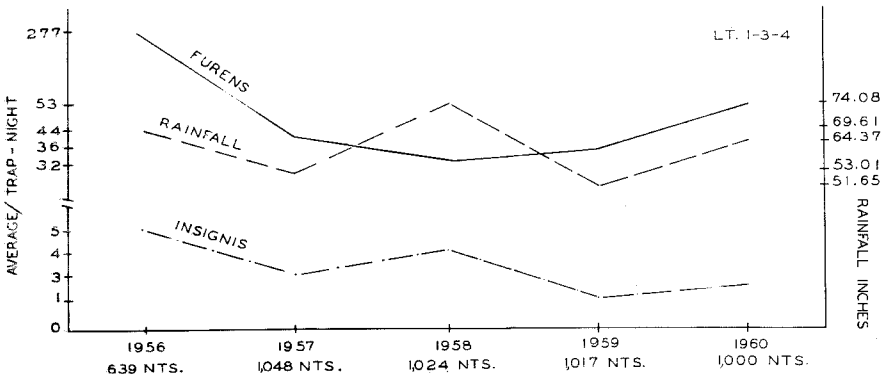

FIG. 3.—*C. furens* and *insignis*, the yearly average per light trap-night of the total of Lt. 1, Lt. 3, and Lt. 4 compared with the rainfall.

were in March (96.8 specimens per trap-night) and April (86.4 specimens), but the rainfall was very low during these months, 1.51 and 1.14 inches respectively. Similar results were obtained in 1958 and 1960; and it was not possible to relate the monthly light trap counts to either the dry or wet periods of the years of study in a consistent way (Fig. 4 and 5).

Counts from each of the light traps which were run more or less regularly were analyzed on a weekly basis, with the results shown in Figures 7, 8, 9, 10 and 11. The yield differed greatly among the different light-traps; for example Lt. 4 and Lt. 8 consistently were very low and Lt. 1 and Lt. 7 very high indicating the importance of the locations of the traps. Since these two traps were nearest the Torrecilla Lagoon, it is likely that the more extensive breeding places were there (Fig. 12). Although trends were clearly evident, a light-trap could show considerable variation from week to week; thus in May and June, 1960, Lt. 1 yielded 10 and more times as many specimens in some weeks as in others, proving the necessity for continuous nightly operation throughout the year. No consistent relationship between the weekly average per trap-night and the weekly rainfall in inches could be found.

At San Juan, Puerto Rico there is a daily low and high tide in the period from 12 midnight to 12 noon and also a low and a high tide in the post meridian period. The daily variation in the height of the tide is between one and two feet and there is also a seasonal variation. To obtain the average monthly predicted height of the high tides in feet,

TABLE 1.—Yearly average per light trap-night, with the yearly rainfall in inches shown in parenthesis

	1956 (69.61)	1957 (53.01)	1958 (74.08)	1959 (51.65)	1960 (64.37)
Lt. 1	531.4	106.6	39.2	83.8	153.3
Lt. 2	53.9	56.8	..	..	..
Lt. 3	49.4	21.2	50.7	22.2	14.0
Lt. 4	18.5	7.3	3.2	3.0	2.0
Lt. 5	8.9	5.7	..	..	..
Lt. 7	..	..	88.2	40.8	59.7
Lt. 8	..	..	7.6	7.1	4.7

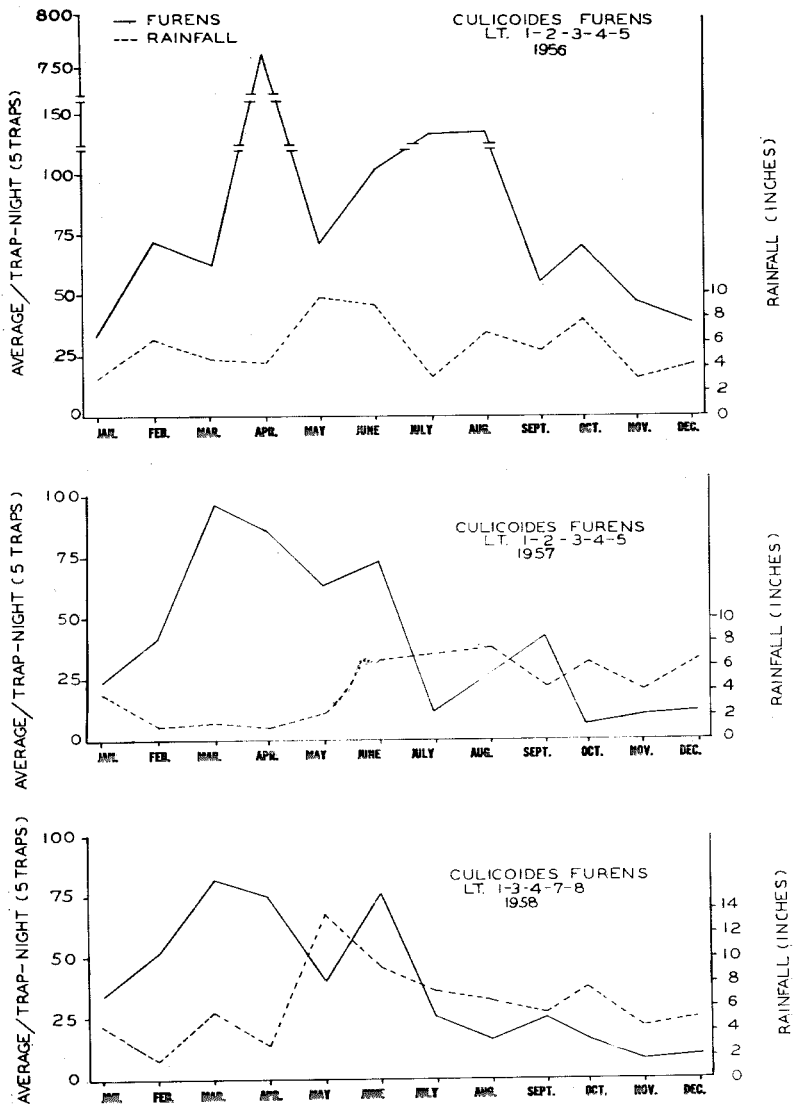

FIG. 4.—*C. furens*, monthly average per light trap-night of the total of Lt. 1, Lt. 2, Lt. 3, Lt. 4, and Lt. 5, for 1956 and 1957, and the total of Lt. 1, Lt. 3, Lt. 4, Lt. 7, and Lt. 8 for 1958 compared with the monthly rainfall.

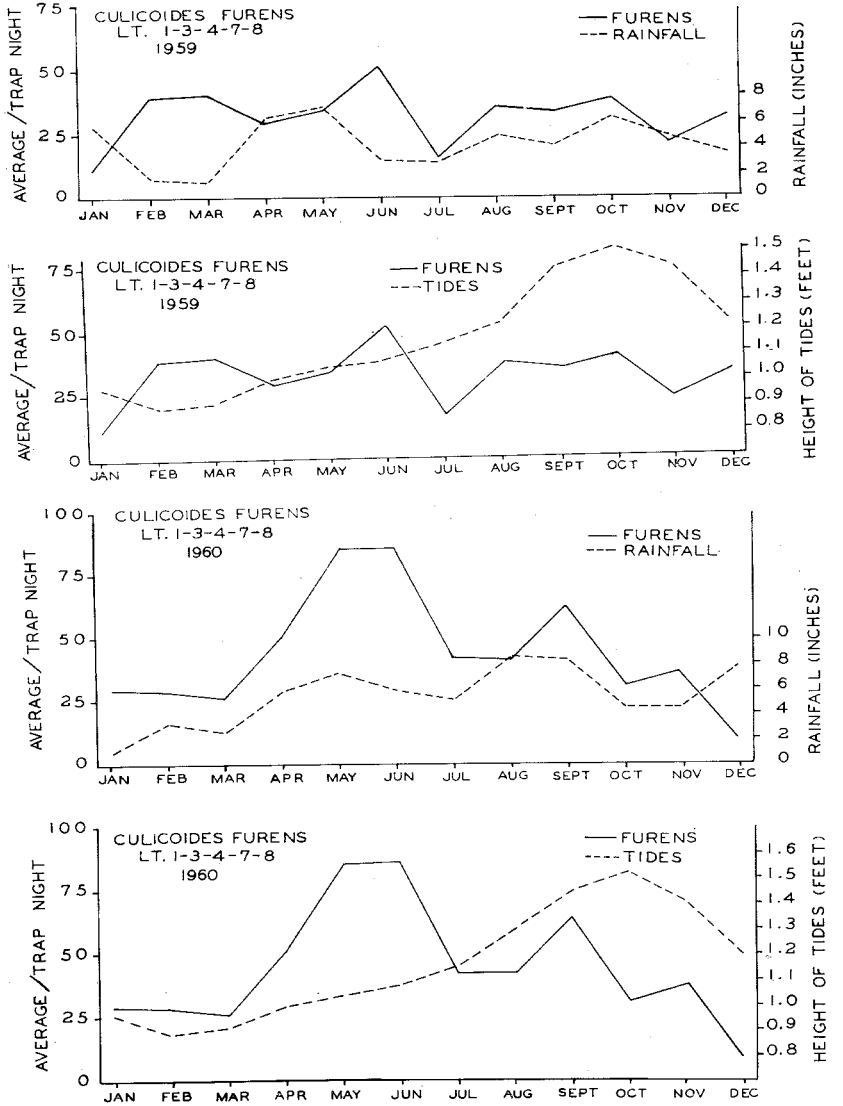

FIG. 5.—*C. furens,* monthly average per trap-night of the total of five traps compared with the monthly rainfall in inches and the monthly average predicted height of high tides in feet for 1959 and 1960.

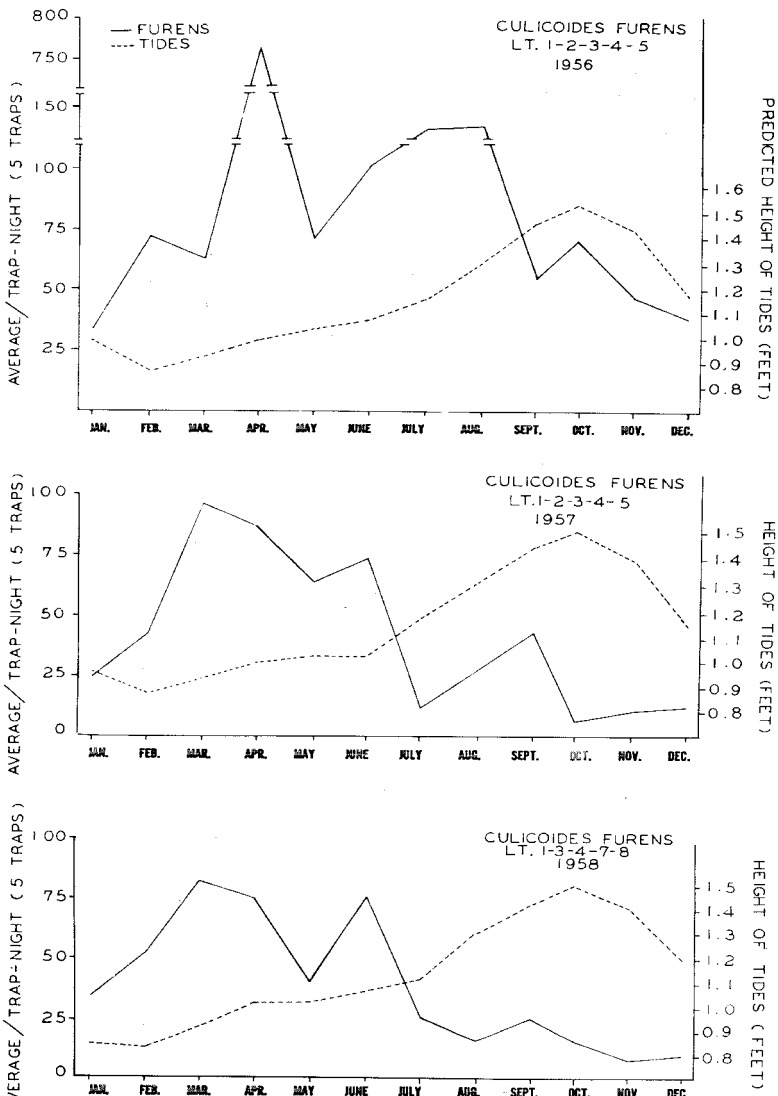

FIG. 6.—*C. furens,* monthly average per trap-night of the total of five light traps compared with the monthly average predicted height of high tides for 1956, 1957, and 1958.

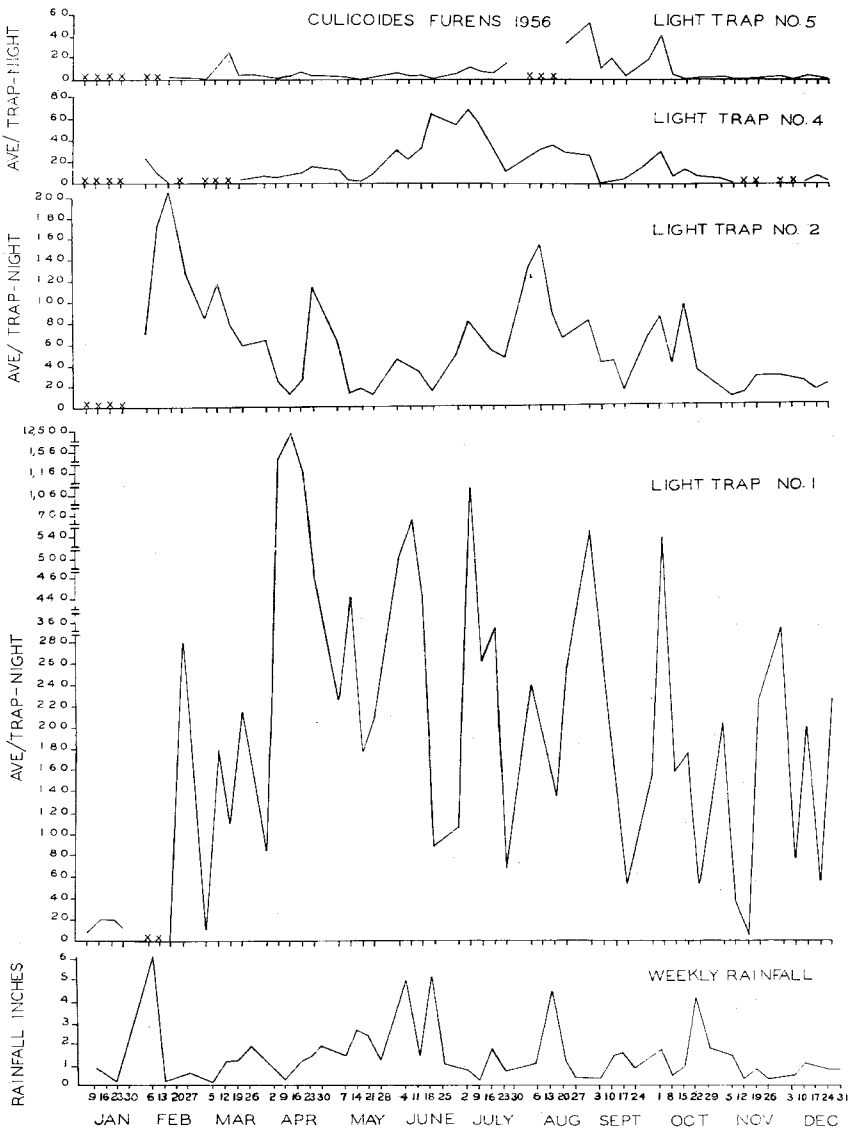

FIG. 7.—Weekly average per trap-night of *C. furens* for each of four light traps (the letter "x" indicates that the light trap did not operate) compared with the weekly rainfall in inches in 1956.

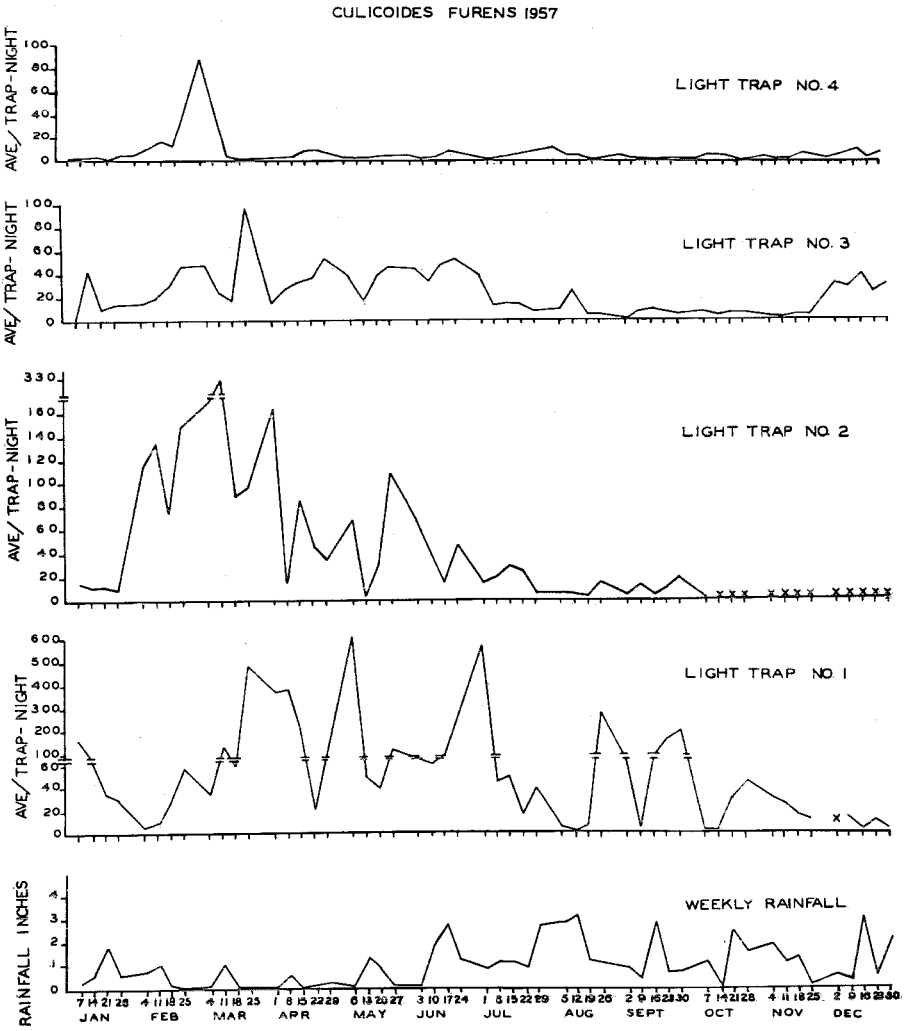

FIG. 8.—Weekly average per light trap-night of *C. furens* and the weekly rainfall in 1957.

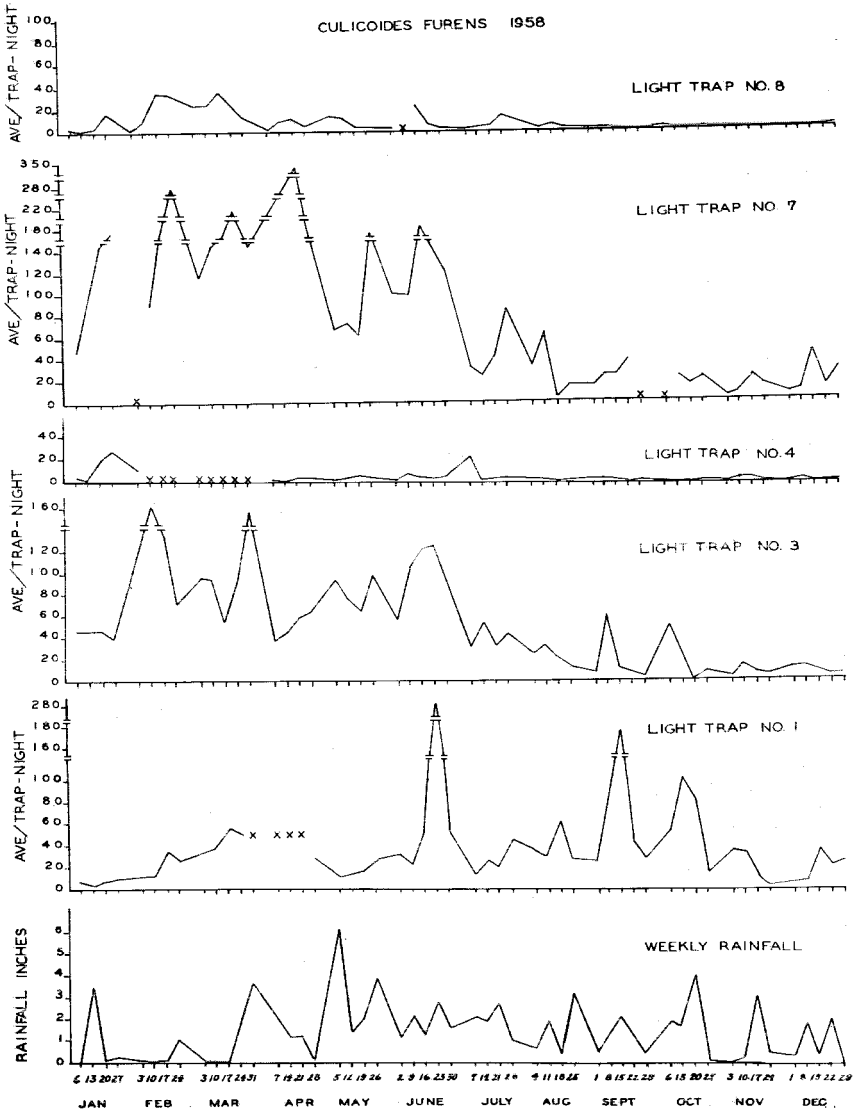

FIG. 9.—Weekly average per light trap-night of *C. furens* and the weekly rainfall in 1958.

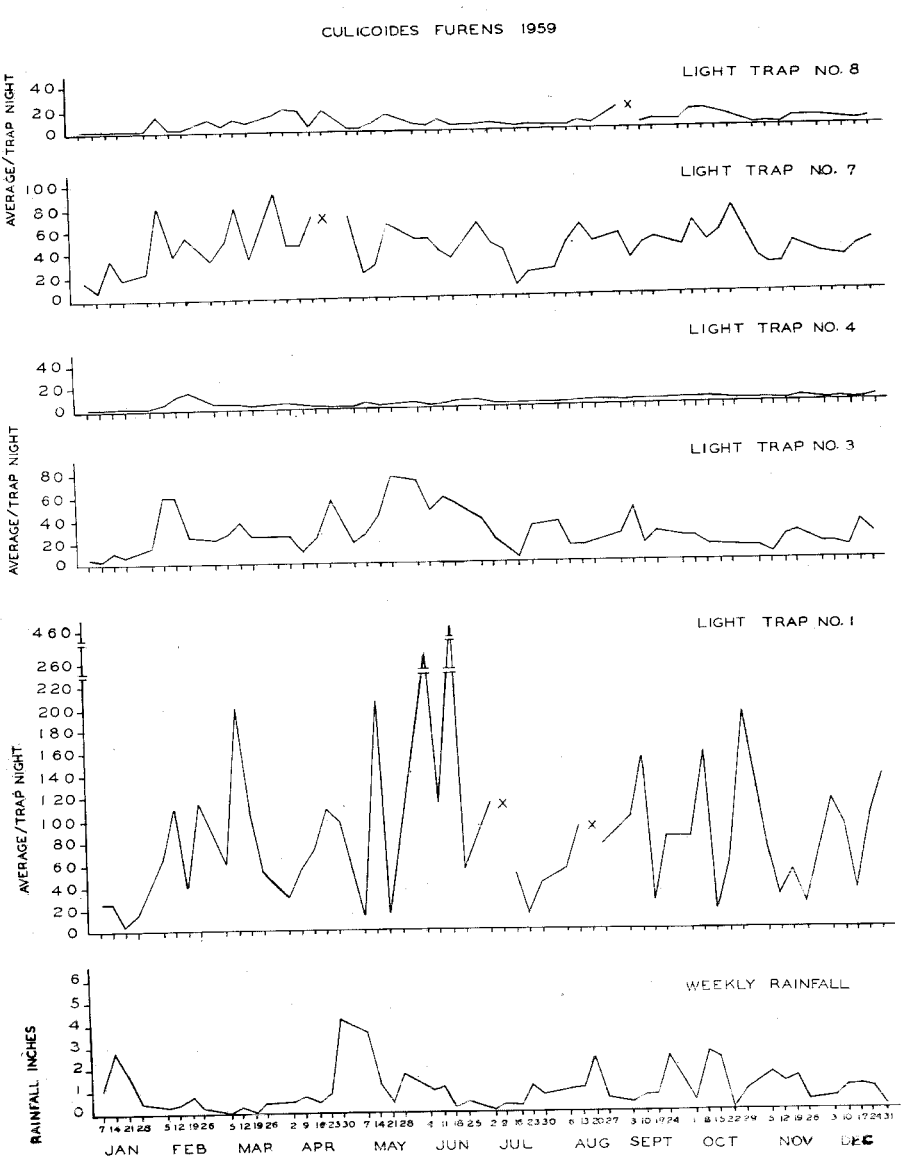

FIG. 10.—Weekly average per light trap-night of *C. furens* and the weekly rainfall in 1959.

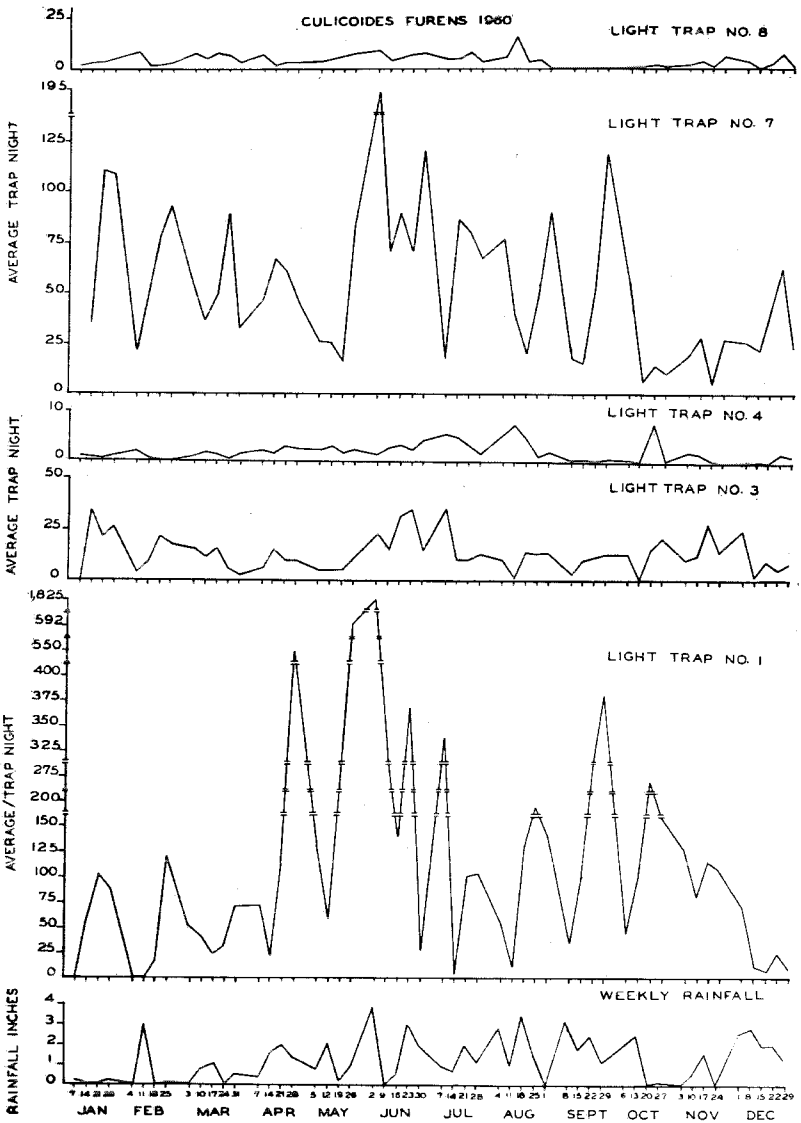

FIG. 11.—Weekly average per light trap-night of *C. furens* and the weekly rainfall in 1960.

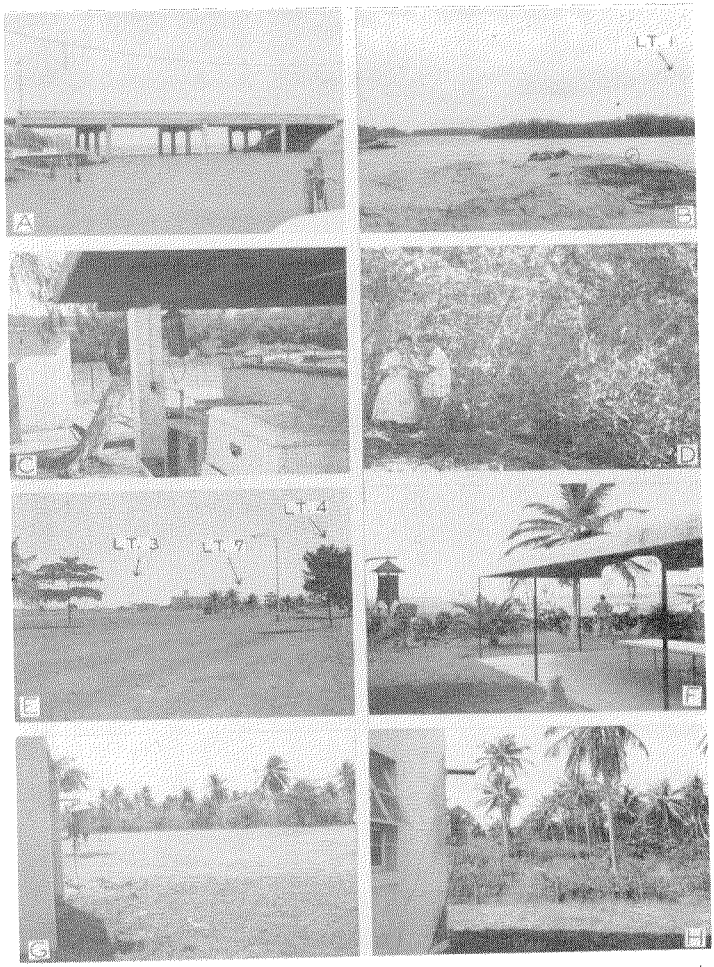

FIG. 12.—Bridge at the entrance to Torrecilla Lagoon from the Atlantic Ocean, Boca de Cangrejos, Puerto Rico, February 20, 1961. B. Torrecilla Lagoon with arrow indicating the location of Light Trap No. 1 at the Boca de Cangrejos Yacht Club, February 20, 1961. C. Light Trap No. 1, Boca de Cangrejos Yacht Club, February 17, 1961. D. Dense foliage of the mangrove marsh which borders Torrecilla Lagoon, Boca de Cangrejos where adult *Culicoides furens* (Poey) abound, February 20, 1961. E. Location of light traps in relation to the Main Building, International Airport, Isla Verde, Puerto Rico, February 17, 1961. F. Light Trap No. 3, Terminal, International Airport, Isla Verde, Puerto Rico, February 17, 1961. G. Light Trap No. 4, Transformer, International Airport, Isla Verde, Puerto Rico, February 17, 1961. H. Light Trap No. 7, Air National Guard, International Airport, Isla Verde, Puerto Rico, February 17, 1961. (Photographs by Miss Ileana Garcia-Moll, except for D.)

the two high tides of each day as given in Tide Tables (U. S. Department of Commerce, 1955) are averaged and the total sum of the averages are divided by the number of days in the month. Figures 5 and 6 show a relationship more or less consistent from year to year between the monthly average per trap-night of *furens* and the monthly average predicted height of the high tides. The months of lower tides are the months of greatest abundance of *furens*, and during the months of higher tides there are considerably fewer specimens in the light traps. Studies made by Forattini *et al.* (1958) indicate that a Brazilian salt marsh species, *C. marium* Lutz is also abundant at periods of low tides. Analysis of the individual light trap counts on a weekly basis showed that certain light traps yielded much fewer than others and a single light trap would vary considerably from week to week, hence it is necessary to place them advantageously and operate them continuously. In conclusion, the data obtained indicate that light traps are a valuable adjunct for finding out seasonal variation of *C. furens* and for providing population data necessary to gauge control effectiveness. However, it is necessary to check these data by other methods of determining population density such as human biting counts, animal bait traps, and extracting larvae from the soil.

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Charges were made for extra pages in this paper.

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