GEOGRAPHICAL AND SEASONAL DISTRIBUTION OF MOSQUITO SPECIES IN SOUTHEASTERN CALIFORNIA[1]

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ABSTRACT. The distributions of 15 species of mosquitoes are described for the agricultural and natural areas of the Sonoran Desert in Imperial and Riverside Counties, California, for July, 1968, through July, 1969. Patterns of distribution vary with mosquito abatement practices, the effectiveness of the drainage systems in preventing pooling and persistence of irrigation water, the amount of natural waters, the type of agriculture, and less obvious factors, within the total situation. *Culex tarsalis, Culiseta inornata,* and *Psorophora confinnis* are nearly ubiquitous in the study area; *Aedes vexans,* and *Anopheles p. franciscanus* are almost as widely distributed, but occur with less frequency. *Aedes dorsalis* and *Culex erythrothorax* were captured almost exclusively in the southern and eastern part of the area (Imperial Valley and Palo Verde Valley); *Culex p. quinquefasciatus* was most abundant in the northwest (Coachella Valley). The other species had very limited spatial distributions. There was a definite seasonality of occurrence. The peaks of abundance of the eight most common species were almost mutually exclusive. Two species showed completely different seasonal patterns in different parts of the area.

INTRODUCTION

This is the initial report on a study of the ecology of mosquitoes in the arid portions of southeastern California. This is an important agricultural region by reason of its good soil and abundant irrigation water. Imperial County ranks first in cattle production in California; Imperial County ranks fourth and Riverside County ranks sixth in overall agricultural commodity production in California. The Salton Sea and Colorado River are major recreation areas. Therefore, the region is one of considerable interaction between humans and their domestic animals and mosquitoes. We were first concerned with determining the general distribution of the species of mosquitoes in space and time. The present report emphasizes only the distribution of adult mosquitoes. It is more difficult to obtain quantitative information on the aquatic stages; this work is continuing and will be reported later.

MATERIALS AND METHODS

THE STUDY AREA. The study area and the location of our collecting sites are shown in Fig. 1. This report emphasizes the collections from 22 New Jersey light trap sites (numbered X's in Fig. 1) that were operated continuously from July, 1968, through July, 1969. The numbered triangles in Fig. 1 are the locations of six Malaise traps that were operated from February, 1969, onward. The unnumbered circles are the locations of six New Jersey traps that were operated only 10–39 weeks, 34 sites where adults were collected 1–18 times (a median of 3 times) by means of miniature light trap, carbon dioxide trap, or red-box shelter, and 80 of the 102 aquatic sites, sampled 1–13 times (median 4). All the sites are below an elevation of 305 m, and most are below 150 m, i.e., they are well within the part of the Sonoran Desert that extends into California.

About ¾ of the collecting sites are within four areas that are irrigated by water from the Colorado River, shown enclosed by stippled borders in Fig. 1: (1) the Coachella Valley, northwest of the Salton Sea, (2) the Imperial Valley, south and east of the sea, (3) the Palo Verde Valley, along the Colorado River, in Riverside County, and (4) the area around Winterhaven, in extreme southeastern California. Our samples from

[1] This work has been supported by grant AI 08284 from the National Institute of Allergic and Infectious Diseases of the U. S. Public Health Service.

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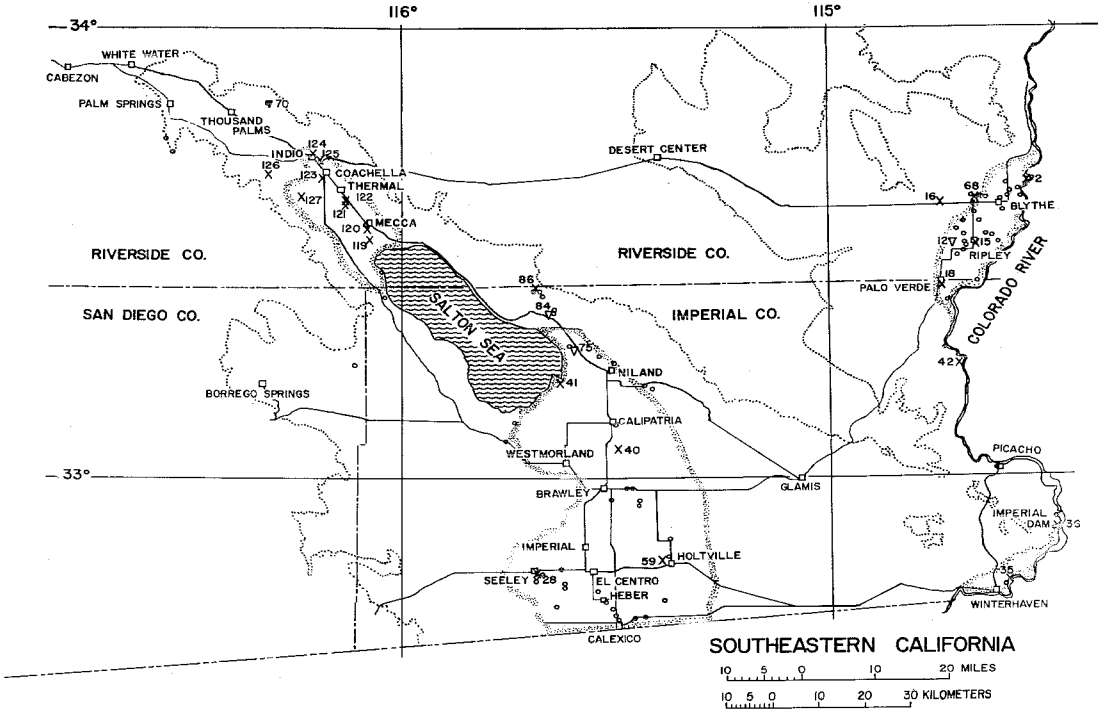

FIG. 1.—Map of the study area. Numbered X's are sites where New Jersey light traps were operated continuously, numbered triangles are Malaise trap sites, open circles are other terrestrial and aquatic sites. Dotted line is the 305 m contour line; stippled borders enclose areas that are irrigated by water from the Colorado River.

these collecting sites represent mosquito populations that are breeding largely in irrigation and runoff water. The remaining sites are in non-agricultural areas where the mosquito populations develop in "natural" waters: seepage ponds, streams, the Salton Sea and contiguous marshes, ponds and lakes along the Colorado River. The large areas of the map of Fig. 1 without collecting sites have almost no surface water, except after rains, and typically do not support mosquito populations.

The long term weather records of the weather stations at Indio (Coachella Valley), Blythe (Palo Verde Valley), and El Centro (Imperial Valley) suggest that these valleys have the same temperature regimen. Mean annual temperatures are 23.4, 22.2, and 22.6° C, respectively. In the warmest months, the ranges of the mean monthly temperatures for the three stations are: June, 29.5–30.2; July, 33.3–33.4; August, 32.4–32.8; and September, 29.6–30.1° C. In the coldest months the ranges are: December, 12.1–13.2; January, 14.4–14.5; and February, 13.9–14.5° C.

The long term mean annual rainfalls are: Indio, 86; Blythe, 101, and El Centro, 67 mm. These values are probably not significantly different, since there is considerable variation from year to year. In 1968, the departures from the long term averages were —30, —70, and —28 mm, respectively. April through June is the driest period, with no more than 3.3 mm/month; December through February is the wettest period, with 10.4–17.3 mm/month.

COLLECTING METHODS. Adult mosquitoes were collected continuously by New Jersey light traps and by nonattractant Malaise traps (Townes, 1962). The nine New Jersey traps located in the Coachella Valley (sites 119 thru 127, inclusive) were operated by personnel of the Coachella Valley Mosquito Abatement District (CVMAD). Data from these traps were generously made available to us to be reported here by Mr. Lenord Moore, entomologist of the CVMAD. All other traps were operated for us by interested laymen who volunteered their services. Collections were removed from the traps weekly, or every 2–3 days in the summer at some sites, and were mailed to our laboratory for sorting and identification.

Each month we spent 6–8 days touring all the terrestrial collecting sites. At these times spot collections of adults were made by miniature light trap (Sudia and Chamberlain, 1962), carbon dioxide can traps (Bellamy and Reeves, 1952), and from red-box shelters and natural shelters. We also drove a standard route to check the current irrigation waters for the presence of larvae and pupae, and to visit established aquatic collecting sites. Larvae and pupae were collected by dipper and large pipette. Pupae were kept alive until adults emerged, so positive identifications could be made.

NEW JERSEY TRAP COLLECTING SITES. The 22 locations where New Jersey traps were operated continuously, as well as the other sites, can be separated into four broad categories.

Category 1 (C1). Coachella Valley. An agricultural region with relatively poor drainage; an organized mosquito abatement program is present. Sites 119–127.

Category 2 (C2). Imperial Valley and Winterhaven area. Agricultural region with good drainage; little temporary or permanent water; no organized mosquito abatement. Sites 28, 35, 40, 59.

Category 3 (C3). Palo Verde Valley. Agricultural region with poor drainage; much standing runoff water and permanent natural water; no organized mosquito abatement. Sites 2, 15, 18, 68.

Category 4 (C4). Non-agricultural regions with native vegetation and natural waters; no mosquito abatement. Sites 16, 36, 41, 42, 86.

Crops are irrigated at 7–10 day intervals, year around, which provides ample water for the development of mosquitoes wherever drainage is poor. In the Coachella Valley, the CVMAD conducts a chemical mosquito control program from April to November. There is no orga-

nized mosquito control program in the Palo Verde or Imperial Valley, but there was heavy aerial spraying for the pink bollworm in 1968 and 1969 which could have affected mosquito densities.

The nine sites in the Coachella Valley (C_1) represent a variety of situations: areas of diversified crops, areas with emphasis on grapes and dates, urban areas, regions that are largely unused fields grown up to weeds, and land in desert shrub vegetation. No livestock is within at least 1.6 km of ⅔ of these trap sites. The specific crops, as they determine the irrigation pattern and mosquito abatement practices, the availability of livestock for blood meals and the nature of the cultivated and natural vegetation, all influence the potential for development of the different species of mosquitoes (Gunstream, 1964; Gunstream and Chew, 1964).

In Imperial Valley and the Winterhaven area (C_2), cotton, alfalfa, sugar beets and cattle are the principal crops. Site 59 provided mosquitoes the diversity of irrigated alfalfa, cattle feed lots, and the riparian vegetation along the Alamo River. Site 35 was near a low area of about 1 hectare of mesquite, tamarisk, and arrowweed that was occasionally flooded by excessive irrigation runoff. Such failure of drainage is exceptional in category 2. Two New Jersey traps were located near artificial lakes, site 28 near Sunbeam Lake, and site 40, 0.4 km from Finney Lake.

In the Palo Verde Valley (C_3), site 2 is located next to the Colorado River, and site 18 is in Palo Verde (population 620) at the southern end of an extensive lagoon from the river; neither site had livestock within 1.6 km. Site 15 was in the middle of the small community of Ripley (population 300); a few domestic animals were present, but there was no permanent water or chronic drainage problem. Site 68 was in an area that provided irrigated crops, a small feed lot, and, usually, standing water in ditches in a cattle pasture.

A variety of environments is provided by the natural areas (C_4); none has livestock within 1.6 km. Site 16 is in desert vegetation on the mesa (119 m elevation) west of the Palo Verde Valley; no standing water was found within 6.4 km of the site. Site 36, Imperial Dam, is in the midst of a variety of aquatic sites: temporary and permanent marshes, ponds, lakes, canals, impoundments, and the Colorado River. The waters range from fresh to saline. Desert scrub vegetation dominates except next to the water. Site 41 is where the Alamo River empties into the Salton Sea; there are marshes and trees along the sea and the river. About 200 hectares that are managed for waterfowl are flooded in season and planted to bulrush, millet, and rice. Site 42, Walter's Camp, is next to the Colorado River. An extensive cattail marsh with isolated pools of water is 0.5 km north; otherwise, desert vegetation is immediately inland from the river. Site 86 is in an area of tamarisk, palo verde, and desert shrubs, where there is an overflow from mineral spas; 1.1 km southeast there are numerous ground pools and several small ponds of fresh water formed by seepage from the Coachella Canal which is 76 m uphill from the site.

RESULTS AND DISCUSSION

GEOGRAPHICAL DISTRIBUTION OF SPECIES. Fifteen species were identified in the collections of adults and larvae made through August, 1969. These species are listed in Table 1, with the values for their presence and frequency. Presence (P) = (no. sites at which a species was collected) / (total no. sites). Frequency was calculated for those sites where the species was present: F = (no. collections in which species was represented) / (total no. collections).

Three of the 15 species are nearly ubiquitous in the study area: *Culex tarsalis* Coquillett, *Culiseta inornata* (Williston), and *Psorophora confinnis* (Lynch Arribálzaga). These species were found at

TABLE 1.—Summary of presence and average frequency of mosquito species.

Species	Coachella Valley Category 1		Imperial Valley Category 2		Palo Verde Valley Category 3		Natural areas Category 4		All terrestrial sites	All aquatic sites
	P (9)	F	P (4)	F	P (4)	F	P (5)	F	P (67)	P (101)
A. dorsalis	...	...	0.50	0.27	1.0	0.24	0.80	0.084	0.31	0.079
A. nigromaculis	...	...	...	...	...	...	...	...	0.015	...
A. taeniorhynchus	...	...	...	...	...	...	0.20	0.098	0.030	...
A. vexans	0.89	0.16	0.75	0.11	1.0	0.21	0.80	0.37	0.46	0.059
A. p. franciscanus	0.67	0.16	0.50	0.034	0.75	0.12	0.60	0.14	0.40	0.23
C. apicalis	...	...	...	...	...	...	...	...	...	0.020
C. erythrothorax	...	...	1.0	0.033	1.0	0.13	1.0	0.11	0.46	0.069
C. peus	0.56	0.041	...	...	...	...	...	...	0.11	0.010
C. p. quinquefasciatus	1.0	0.56	0.50	0.064	0.75	0.11	...	...	0.42	0.21
C. tarsalis	1.0	0.73	1.0	0.52	1.0	0.61	1.0	0.73	0.90	0.82
C. thriambus	...	...	...	...	...	...	...	...	0.030	0.069
C. incidens	0.22	0.018	...	...	...	...	...	...	0.075	0.020
C. inornata	1.0	0.53	1.0	0.51	1.0	0.50	1.0	0.57	0.64	0.52
P. confinnis	1.0	0.26	1.0	0.27	1.0	0.47	0.60	0.16	0.61	0.25
P. signipennis	...	...	...	...	0.25	...	...	...	0.015	...

[1] P, presence at the number of stations in parentheses.
F, frequency in the collections at those sites where the species was present, average for sites.

all the New Jersey trap sites, except that *P. confinnis* was not present at two sites in natural areas (C4). The frequency of capture (F) at all the New Jersey sites together ranged from an average of 0.74 for *C. tarsalis,* which is present all months, to 0.53 for *C. inornata,* present September through May or June, to 0.29 for *P. confinnis,* present only April or May through October or November. The presence (P) of these species at all 67 terrestrial sites was 0.90, 0.64, and 0.61, respectively; presence at all 101 aquatic sites was 0.82, 0.52, and 0.25, respectively (Table 1). *Aedes vexans* (Meigen) and *Anopheles pseudopunctipennis franciscanus* McCracken are distributed almost as widely, but they have lower presence and frequency.

Three species that have intermediate P and F values show variations of distribution with regard to the four categories of sites. *Aedes dorsalis* (Meigen) was not captured in the Coachella Valley, nor was it taken at sites in natural areas northwest of the Coachella Valley and around the Salton Sea, except for site 41. With this exception, all of our collections of *A. dorsalis* are southeast of a line from Brawley, in Imperial Valley, to the western edge of the Palo Verde Valley. This limited distribution is surprising in view of the versatile habits of the larvae (Horsfall, 1955:432). *A. dorsalis* may be absent from the Coachella Valley because of the mosquito abatement practices directed at another temporary water species, *P. confinnis.*

Culex erythrothorax Dyar also was not captured in the Coachella Valley, but it was taken at all the other New Jersey trap stations, although only in small numbers and with a low frequency. *C. erythrothorax* was most abundant at sites 36 and 84 (C4). These two sites are similar to the larval habitat of the species described by Horsfall (1955:562): i.e., marshes and shallow ponds with emergent bulrushes and grasses. The New Jersey traps, including the one at site 36, where both N.J. and Malaise traps were used, never captured more than 18 *C. erythrothorax* in one month. Our limited results suggest that light traps are not effective in capturing this species.

The presence and frequency of *Culex pipiens quinquefasciatus* Say at the New Jersey trap sites show a direct relationship to human population density: values for Coachella Valley>Palo Verde Valley>Imperial Valley>natural areas. This is to be expected of a mosquito that breeds in domestic containers and foul water (Horsfall, 1955:567), since the incidence of such situations probably is directly related to human population density.

Seven species had very low presence at our collecting sites (Table 1). Adult *Aedes taeniorhynchus* (Wiedemann) were captured only at two sites along the Colorado River; it was briefly abundant at site 42. Although this species characteristically develops in brackish or salt water (Horsfall, 1955:452), we have not located any such waters near where the adults were collected. This species was not taken in or near the 13 aquatic sites that had conductivities greater than 10,000 micromhos/cm. Although Loomis (1959:22) reported that *A. taeniorhynchus* was "found inland in brackish water situations such as around . . . the Salton Sea," we did not collect it at any of our 6 terrestrial sites and 10 aquatic sites (6 brackish) that were 0.8 km from the Salton Sea. Apparently, the Salton Sea does not have much potential for the development of *A. taeniorhynchus* and other "salt-water" mosquitoes.

A single adult *Aedes nigromaculis* (Ludlow) was captured at the site near Picacho (Fig. 1). Loomis (1959) listed *A. nigromaculis* as present in both Imperial and Riverside Counties.

Larval *Culex apicalis* Adams were collected from isolated pools in Palm Canyon and Andreas Canyon, at 152–228 m elevation, in the San Jacinto Mountains. These sites are consistent with the description of the species as a common inhabitant of woodland pools below 1524 m in California (Freeborn and Bohart, 1951).

Possibly the larvae of *C. apicalis* cannot tolerate the summer temperatures at the other sites in our study area, which are all lower and warmer.

A few adults of *Culex peus* Speiser were captured at each of five sites in the Coachella Valley, one site in Palo Verde Valley, and one site in a natural area in Imperial County; larvae were collected only once, in natural waters. *C. peus* was not listed as occurring in Imperial County by Loomis (1959). Because the Coachella Valley has the highest human density of the four categories, it may offer more opportunity for breeding by *C. peus,* which usually occurs in polluted water (Horsfall, 1955:591). *C. peus* larvae have been found abundantly in sewage effluent at Riverside and at Ontario, Calif., northwest of our study area (Sjogren, 1968).

Adults of *Culex thriambus* Dyar were collected in two natural areas in the northwestern end of the Coachella Valley, beyond the region irrigated by water from the canals. Larvae were collected at seven sites, all in natural areas. Three of these sites are in Imperial County; Loomis (1959) did not record the species for Imperial County.

Adult *Culiseta incidens* (Thomson) were collected at five sites, and larvae at two sites; these sites were distributed among all categories except Imperial Valley (C2). The wide distribution is consistent with the description of the species as being found in all sorts of situations (Horsfall, 1955:351).

One adult *Psorophora signipennis* (Coquillett) was captured at Picacho State Park, on the Colorado River south of site 42 (Fig. 1); another was captured at site 15, Ripley, which is only 6.5 km from the river. This species is not reported for California by Carpenter and LaCasse (1955), Loomis (1959), or Carpenter (1968), although it is recorded for Arizona.

We did not collect *Anopheles freeborni* Aitken or *Culex pipiens pipiens* which Loomis (1959) listed as present in Riverside and Imperial Counties. Since the identification of *A. freeborni* is easy, we conclude that it was not overlooked in our collections, and that it has a very spotty and limited distribution in these counties. We assigned all of our specimens of *C. pipiens* to the sub-species *quinquefasciatus* Say because Freeborn and Bohart (1951:56) reported that *C. p. "pipiens* does not occur south of San Joaquin County except along the coast, where it extends as far as San Diego."

Loomis (1959) listed seven other species for Riverside County that we did not collect, most or all of which are not to be expected in the Sonoran Desert part of the county.

DISTRIBUTION OF SPECIES IN TIME. There is a definite seasonality of mosquito species. There was little overlap of the peaks of abundance of the eight most common species in 1968–1969, particularly in the same site category. *A. vexans* and *C. erythrothorax* had maximum numbers in April and May. *A. dorsalis* reached its peak in July. *P. confinnis* had its peak development in August 1968 in the Coachella Valley and in September in other areas (Fig. 3). *C. inornata* was most abundant in November and persisted through the winter in numbers equal to 26–56 percent of the peak (Fig. 2). *C. tarsalis* in the Coachella Valley was the only other population that persisted through the winter in any numbers (Fig. 5). Two species had both fall and spring peaks, but these were in different populations. *A. p. franciscanus* was most abundant in October in the Coachella Valley and in June in natural areas (Fig. 4). *C. tarsalis* had peak numbers in October in the Coachella Valley and in May and June in other areas (Fig. 5). *C. p. quinquefasciatus* was present in small numbers in all months in the Coachella Valley; there was no definite peak, but the highest numbers were in summer and fall.

The period that a species was present in numbers at least 10 percent of its peak varied from 2 months for *A. vexans* to 8 months for *C. tarsalis.* Total annual

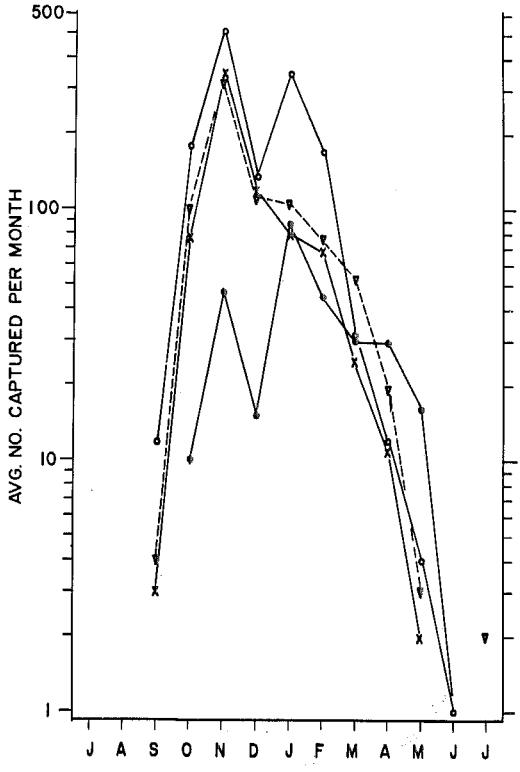

FIG. 2.—Size of monthly collections of *Culiseta inornata* in New Jersey traps. Means for all sites in each category plotted logarithmically; open circles, C1; solid circles, C2; X's, C3; and triangles, C4.

occurrence varied from 5 months for *A. vexans* and *C. erythrothorax* to 12 months for *C. tarsalis* and *C. p. quinquefasciatus*.

The "division of the year" among the mosquito species probably depends largely upon the fit between species' abilities and the environmental conditions. For example, in the Coachella Valley, *P. confinnis* can tolerate water temperatures of 32–35° C and higher, and complete their aquatic stages in 80–120 hours. This is a necessary rate of development if the individuals are to be able to complete their development within the usual period of persistence of irrigation water in the summer. However, survival to adult emergence is optimum at a lower temperature, 24–29° C (Gunstream and Chew, 1967). Judging from evidence for other kinds of organisms, it is likely that the seasonal spacing of species of mosquitoes has involved a character-displacement type of evolution, resulting in a minimum of interspecific competition. Some overt competition may also be involved in limiting periods of species abundance (Peters *et al.*, 1969).

Figures 2 through 5 show the patterns of change in numbers with time for some of the species. Each curve is the average for those stations in a category at which the particular species was well represented, relative to the other sites. We have assumed that the number of indi-

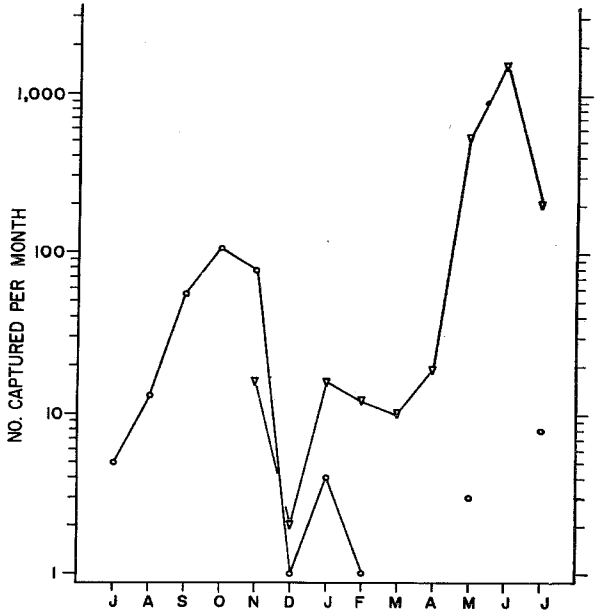

FIG. 3.—Size of monthly collections of *Psorophora confinnis* in New Jersey traps. Means for all sites in each category plotted logarithmically; open circles, C1; X's, C3.

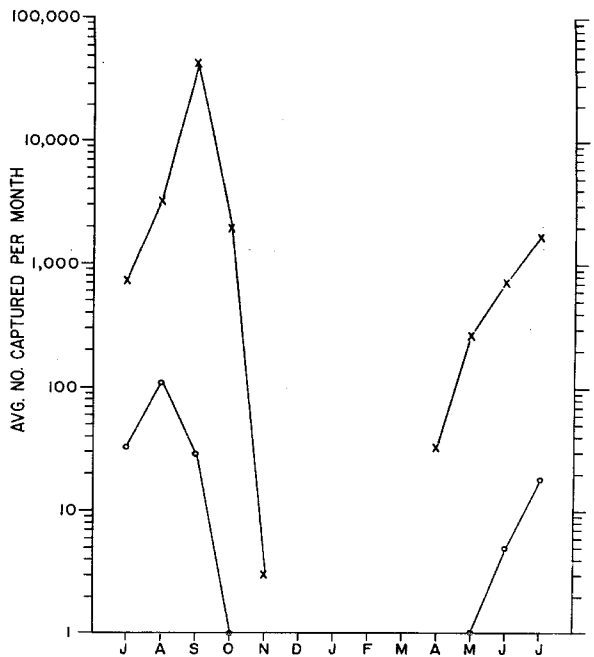

FIG. 4.—Size of monthly collections of *Anopheles p. franciscanus* in New Jersey traps. Numbers plotted logarithmically; open circles, site 119 (C1); triangles, site 86 (C4).

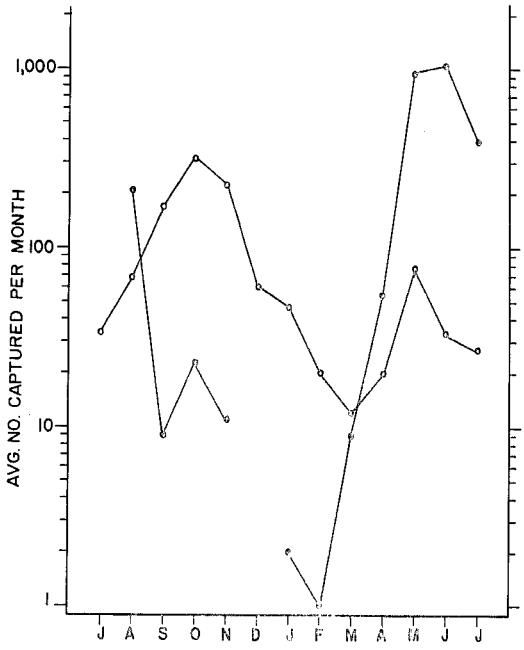

FIG. 5.—Size of monthly collections of *Culex tarsalis* in New Jersey traps. Means for all sites in each category plotted logarithmically; open circles, C1; solid circles, C2.

viduals captured each month is a consistent index of the population density of adults, as have other investigators, although there are several ways in which this relationship can be confounded (Southwood, 1966).

C. inornata occurs in late fall and winter in our study area (Fig. 2). *C. inornata* is notable for the similarity of the population curves for categories 1, 3, and 4. Imperial Valley (C2) differs in that the curve is shifted 1 month later, and it has the major peak in January rather than November. *C. inornata* and *A. vexans* are the only common species in the study area for which the numbers in the Coachella Valley are the same as, or greater than, the numbers elsewhere. These species have their maximum numbers in the winter and spring respectively, which is when the least spraying and larviciding for mosquitoes is being done by the CVMAD. The larval habitats of *C. inornata* (Horsfall, 1955:352) suggest that the species has a broad tolerance of water conditions; this is consistent with our observation that it can develop similar sized populations in regions of diverse water conditions.

C. inornata had its greatest numbers and longest presence at sites 16 and 42 (C4) and site 68 (C3). The species was present for 9 months at all three sites, September through May, and had maximum numbers in November of 660, 300, and 840 individual/month, respectively. The numbers and persistence of this species at site 16 are surprising, since this is the most arid situation that we examined on a continuous basis. No semipermanent water was found within 6.5 km. of the light trap.

P. confinnis had sharp peaks of abundance in late summer or early fall (Fig.

3). Numbers are lowest in the Coachella Valley (C1), undoubtedly a result of the abatement practices of the CVMAD. The maximum numbers and length of presence in categories, 2, 3, and 4 are directly related to the amount of temporary water available, i.e., Palo Verde Valley (C3)>Imperial Valley (C2)>nonagricultural sites (C4). The average peak abundances for sites in these categories were 44,400, 5000, and 1190/month, respectively; seasons of presence were 8, 7, and 4 months. *P. confinnis* was most abundant at site 68 (C3), where 195,000 individuals were captured in September, 1968. Site 59 (C2) had a peak of 14,900 in September, and site 15 (C3), 6300 in August, 1968. All these sites provide the abundance of irrigation water and proximity to cattle and horses, which Gunstream (1964) showed to be necessary for the development of large populations of *P. confinnis* in the Coachella Valley.

A. p. franciscanus had completely different temporal patterns at the two sites where it was common (Fig. 4). At site 86 (C2) the species was present from November through July, with a peak of 1560 individuals in June, 1969. At site 119 (C1) it was present from July through February, with a maximum of 109 individuals in October.

C. tarsalis had a bimodal pattern in the Coachella Valley, with a major peak in the fall of 1968 and a secondary peak, ¼ as high, in the spring of 1969 (Fig. 5). In the other categories, *C. tarsalis* consistently had a single peak in May or June, 1969. *C. tarsalis* developed equally well in all areas; at least one station in each category had the species present continuously, and with maxima of 1120–2900/month (sites 119, 40, 18, 41, and 42). The sites in the Coachella Valley (C1) had the lowest average maximum, 319/month, as compared to an average of 1020/month for Palo Verde sites (C3), 780 for Imperial Valley (C2), and 750 for nonagricultural sites (C4). This species is suppressed by the abatement practices of the CVMAD. We cannot see any effect of the spraying for pink bollworm on this or other mosquito species.

C. p. quinquefasciatus maintained about the same sized population density throughout the year in Coachella Valley, except for a wintertime depression; collections averaged 3–5/month December to February, and 27/month in other months. This species was most abundant at site 123, where the maximum was 244 in July, 1968, and numbers were greater than 75/month in August through November, 1968, and in April and May, 1969. This relative constancy of numbers and the fact that most of our larval collections (10 of 17) were from shallow ground pools suggest that this species is tolerant of changes in water temperature.

A. dorsalis was abundant only at sites 28 and 35, both in the Imperial Valley area (C2). At site 28 the numbers captured May, June, July, and August 1969, were 7, 67, 1666, and 7 respectively. At site 35 the numbers for April through July, 1969, were 65, 220, 301, and 50. At three sites in the Palo Verde Valley (C3), the average duration of the species was about twice as long but numbers averaged only 3–68/month.

A. vexans was most abundant and most frequently collected at sites on or near the Colorado River (35, 42). At site 35, *A. vexans* was present from April through July 1969, with numbers of 36, 1875, 335, and 6, in successive months. At site 42, no individuals were captured in March; the maximum number of 250 was present abruptly in April, 1969, then 23, 6, and 16 in successive months.

In the Coachella Valley, *A. vexans* was common at only one site, 127. Here the species occurred from July through October, 1968, (2–12/month), and from April through July, 1969, with highs of 103/month in May and 132 in June. This is quite different from the 1962–1963 season, when *A. vexans* was abundant at only one site, 119, and was present from late April through late October, with a peak in August, 1962 (Gunstream and Chew, 1964). In 1962–1963,

adults emerged in very large numbers from irrigation lanes in a date ranch that was not subject to chemical control by the CVMAD, up to 27,800/trap night. Obviously, the control program of the CVMAD is very effective in reducing the numbers of this mosquito.

A. taeniorhynchus was present at site 42 in April and May, 1969, with 418 and 20/month, respectively. The only other adults collected were 8 on August 14–16, 1969, in a miniature light trap at Picacho State Park, on the Colorado River, 26.4 km SSE of site 42 (Fig. 1).

C. erythrothorax was captured in numbers greater than 100/month at only the Malaise trap site 84 (C4); in March through July, 1969, there were 186, 786, 769, 13, and 197 individuals/month respectively.

Not enough individuals were captured of the other species to merit comment on distribution of numbers with time.

ACKNOWLEDGMENTS

We gratefully acknowledge the unstinting assistance of Mr. Eric Workman, who has been a research assistant on the project since its beginning. Mr. Francis Lee, Mr. Richard Hasher, Mr. John Nickoloff, and Mr. Jerry Arrow assisted for shorter periods. The extensive collections would have been impossible without the help of the volunteers who operated the New Jersey and Malaise traps for us. These people were: Norman Anderson (site 2), Oscar Bashford and Sydney Dunkerley (86), Alice Brazelton (42), Ray Brewer (18), Don Davis and Gary Moran (15), Joseph Derma (35), Albert Dickerson (41), Charles French (16), Lin Hain (84), Pat Hogue (59), Robert Lacy (68), Horace Miller (12), Norman Nunery (Picacho State Recreation Area), William Sears and John Turner (36), Horace White (28), and Paul Wilhelm (70). We also thank the personnel of the Coachella Valley Mosquito Abatement District for their continued interest in our work and for assistance whenever it was requested. Our work began when the CVMAD was under the direction of the late Mr. Arthur Cavanaugh, and has continued with the CVMAD under the direction of Mr. James E. Pippin, Jr., and then Capt. George S. Stains.

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