# STUDIES OF THE MALARIA PROBLEM IN PORTO RICO

#### Paper IX

## OBSERVATION ON HABITS OF ADULT MOSQUITOES ANOPHELES ALBIMANUS

It has already been stated that no preference could be noted for breeding of this mosquito in water deposits nearest residences. It must be borne in mind, however, that in no case was any water deposit more than three kilometers away from abundant residences.

More striking, however, is the absence of the adults in and about residences during the daytime. Greene, working at Aguirre on the south coast, never was able to catch many adults during the daytime and it was doubtful whether day catches could be used as an index of anopheline density.

At the beginning of the work the contrast between the extensive breeding grounds and the low catches in houses was very marked. The largest number ever caught in a house during the daytime was nineteen and this was at the height of season in November.

## Day Catches.

A total of seventy-two day stations was selected throughout in the area mainly and under houses, though the regions under small bridges, and in horse stables were included. Numerous attempts were made to find adults in caves and among vegetation.

As the season advanced many of the day stations were omitted as more night work was done.

### Night Catches.

It was made known early in the work and included in the plans that it would be necessary to extend observations into the night, particularly during the early evening hours when anopheles are most active. Observations were made—

(1) Personally in an attempt to obtain information on flight or mating. Observations were made at varying distances from known breeding areas just as it was getting dark and for a short time thereafter in an attempt to observe any flight. Observations were more numerous in early summer but were also repeated in late fall and winter.

(2) By use of mosquito-net tents open at bottom and with persons

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under them. During May, June and July this was the most common form of night work. A person was placed under a small mosquito tent net which was open 6-8 inches at the bottom. Observations were begun at dusk and continued about one hour thereafter. Systematic catches were made at varying distances from breeding areas and near residences.

(3) On animals, particularly the horse, oxen, cow and pig. The horse had previously been shown to be chosen often by anopheles, as had been the cow. Observations were most numerous on the former. After August, systematic catches were made on horses at dusk and for an hour thereafter at varying distances from breeding areas. Twenty-six stations were established for this purpose. Generally it was not possible to visit these night stations more often than once in three weeks. For most of the work a black horse was used, but later light-colored horses were also used.

(4) In houses and on persons under observation. If night station was near a house, as most of them were, inspector was instructed to spend about one-half his time catching anopheles off horses and about half collecting in houses or on persons under observation. Mosquitoes caught on horses and in houses were usually kept separated.

From August 1924 till the work closed in May 1925, the main basis of night catches was  $1\frac{1}{2}$  hours spent just after darkness sets in, in search for adult mosquitoes—one-half time to catches on horses and one-half to catches in houses or on persons.

## Results of Day Catches.

Observations were made throughout the season in sixty day stations, in sixteen of which (or twenty-seven per cent) no adults were found at any time during the year. Small bridges, under which it was quite dark and which crossed ditches with heavy breeding, were also repeatedly examined but catches were very small.

The catches were most numerous inside of residences. The general type of house has already been described. It is the common thing to find houses with very few small windows and often the window in the bedroom is always closed so that the room is dark almost twenty-four hours in the day. Numerous houses of this character were examined with aid of flashlight but catches were never large.

In one instance at least, however, day catches were of value in calling attention to an area in which breeding had devoloped unno-

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ticed. At this station an occasional adult was found through July and August. Two weeks in September, however, twelve and fifteen adults, respectively, were caught in the house. During the first part of October few were caught, but the last two weeks and first week in November, sixteen, fifteen and nineteen were caught in the respective weeks. The stations could not be visited again till the last week in November when eight albimanus were found. The week before, thirty-six were caught on a horse in the evening. During December the catches decreased and only an occasional albimanus was caught from then on.

This house was a small thatched one on the beach and separated from the ocean by a low sand hill. It was more or less isolated from neighboring houses. Extensive low lands began about onehalf to one kilometer to the south. After the adults were first found, heavy breeding was found in ditches about one-half kilometer to the south, and this breeding continued through the first half of November. Whether the mosquitoes came from this area or from the low lands which extended away from it cannot be said but the nearest breeding that was found was one-half kilometer away. Flight must have been across the wind.

Two blood smears taken in this house in July were positive for *P. vivax*. On September 26 (after adult catches had increased) a three-year-old girl became sick and blood showed *P. malariae*. No other cases of definite illness were encountered, but in November four out of five in the family who were examined, showed *P. vivax*. Practically the entire family was infected and apparently were chronic carriers. The nearest breeding that was ever found was one-half kilometer away.

#### OBSERVATION OF FLIGHT

The only positive results were reported by Dr. H. H. Howard while observations were being made late in April between two large bayous which at that time were breeding heavily. No concentrated extensive flight was observed but numerous anopheles were seen to rise up out of the heavy vegetation and set out in a direction across the wind and toward the hill section about one kilometer away where the nearest residences were.

Shortly after this time heavy breeding ceased in these bayous and the observation could not be continued. At no other time was heavy breeding found concentrated in a definite area from which observations could be made.

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#### THE CATCHES UNDER MOSQUITO TENTS

These catches were made in May, June and July and never yielded large results even when made in the center of heavy breeding areas, though they yielded many more mosquitoes than day catches. It was possible that there was some defect in use of tent for catches in houses would yield as many if not more on the same night. It is also possible that individuals were used who were not highly attractive to anopheles mosquitoes, for there is certainly considerable individual variation in this respect.

### CATCHES ON DOMESTIC ANIMALS

### The Horse.

Observations in Panama and in the United States had shown that this animal was often bitten by anopheles mosquitoes. Some of the first observations here on horses yielded the largest catches that were made by any method. It was felt that probably a combination of systematic catches made at night on the horses and in houses on human beings would probably give an index of anopheline ciensity as well as some data on food preference.

Proportion of Catches on Horses and on Human Beings or in Houses at Night.

Since as a rule mosquitoes were more readily caught on horses than by any other method it is possible that more time was used by inspectors in examining horses than persons and houses at night. The records show, however, that of slightly over 2,000 albimanus caught at night only one-fourth were caught on persons or in houses.

### TABLE XVIII

## PROPORTION OF MOSQUITOES CAUGHT ON HORSES AND IN HOUSES AT NIGHT

Species	Total catch	Percent on horses	Percent on persons or in houses
A. albimanus	2,123	78	27
A. grabhamii	363	93	7
A. vestitipennis	144	92	8

At last it would seem safe to say that albimanus does not need to rely entirely upon human blood. In the laboratory it seemed to take the mosquito much longer to digest a blood meal from the horse.

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#### Cow.

A few observations, all negative, had been made early in the season on other animals than the horse. On Dr. Howard's suggestion more extended observations were made late in the year. On six different nights comparative catches were made on horses and cows by two inspectors working together. As a rule a black horse and black cow were used but at times comparison was with lightercolored animals. In all, fifty-one albimanus were caught on the horse and ten on the cow. They were caught on light-colored animals as well as the black ones. The grabhamii density was low so that no extended observations were made but during these observations five grabhamii were caught on the horses and four on the cow.

### Oxen.

These animals are a little difficult to examine and need to be tied up. For this reason numerous examinations were not made. Early in the season results were negative. Late in the work in April 1925, an inspector caught three anopheles (species not known as they were mixed with catches off horse) on oxen, on the same night that one hundred nineteen albimanus and seventeen grabhamii were caught on the horse. One anopheles was caught on the pig.

All of these observations need to be extended, but in Barceloneta it would seem that domestic animals, especially the horse, are freely bitten by anopheles mosquitoes. The horse has been used as a bait for systematic catches to obtain an anopheline index. It has been shown in other work that the dark-colored animals are most attractive to anopheles mosquitoes. The lighter-colored animals — even white horses—are also bitten.

## STUDY OF ADULT DENSITY BY NIGHT CATCHES

A total of twenty-seven stations were chosen. In four, or fifteen per cent, no adult albimanus were found.

These four stations (N 38, N 46, N 77, N 67) were at least one kilometer from permanent breeding areas. Two other stations (N 73, N 75) were both more than one kilometer from permanent breeding areas, but as some scattered light breeding developed nearer it was not known if flight had taken place. Only a very few anopheles were caught at these stations.

Table XIX shows average number of anopheles caught between-

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#### TABLE XIX

#### CATCHES OF ALBIMANUS MOSQUITOES ACCORDING TO LOCATION OF STATIONS

Location	Number of catches	Total albimanus	Average per catch
Beach	42	375	9.0
Piche Central	21	52	2.5
Town .	22	5	0.2
Center of cane fields	54	1,194	22.0
Border Hills	37	363	10.0
Inferior	46	34	0.7

Data included from only those stations that showed adults at some time or other during the year.

August and April at stations in various regions of the area studied. The stations on the beach to the north of breeding areas and the stations on the hills bordering low lands to the south show approximately the same average, 9 for the former and 10 for the latter.

Very low catches were found in the town (average 0.2), though somewhat higher (2.5) in the northern extension of town (Piche) and about the sugar factory.

The highest average (22) was found for those stations in the center of the cane fields and which were more or less near permanent breeding areas.

Observations were few to the east but did not show large numbers of adults.

In the stations in the hills one kilometer and more away from permanent breeding grounds the average for catches was 0.7.

It would seem that flights across the wind are very common and flights to the north and south were approximately of equal extent. The wind generally blows from the east.

