

15342

## MOSQUITOES COLLECTED IN DAKAR, FRENCH WEST AFRICA, INCIDENTAL TO ARMY MALARIA SURVEYS

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Routine malaria surveys in the Dakar region of Senegal, French West Africa, necessitated the collection of known and potential malaria vectors. The collection of anophelines was also required in certain other investigations such as field trials with insecticides, life-history studies, effects of DDT, and natural filarial index, of which the latter two have thus far been reported (Kartman, 1946; Kartman and de Silveira, 1946).

Culicine species were collected from time to time primarily in response to requests from the U. S. National Museum. The exigencies of routine work and certain other matters precluded a more thorough investigation of the ecological conditions concerning the mosquitoes of the Cape Verde peninsula. Systematic type of observation and collecting could not be accomplished. Since the collections were mainly confined to native villages, and occasionally to the countryside about Dakar, they cannot but represent a limited sample of the culicid fauna affecting the tip of the peninsula and extending not more than a maximum of about twelve miles eastward from Dakar.

The present paper is primarily a list of the mosquitoes collected, together with short qualitative notes regarding the circumstances of collection. The collections were made between February, 1944, and February, 1945, and all final identifications were made by Dr. Alan Stone to whom the writers wish to acknowledge their appreciation of his enthusiastic cooperation. Specimens were deposited in the collections of the U. S. National

Museum and the Army Medical School. The taxonomic arrangement is in conformity with that of Evans (1938) and Edwards (1941) except as regards *Culex fatigans* Wied. where the synonym *C. quinquefasciatus* Say has been used.

*Anopheles (Anopheles) coustani* var. *ziemanni* Grünberg.

Larvae were collected from shaded yam irrigation ditches in clear water. This does not quite agree with records from Southern Nigeria where the larvae are reported to be restricted to shallow grassy pools or ponds exposed to the sun (Barber and Olinger, 1931). Observations at Dakar showed this species to prefer shaded areas for breeding in conformity with the habits of most species of the subgenus *Anopheles*.

Adult females were extremely rarely encountered in native dwellings even when they were breeding nearby. Less than a half dozen adults were taken in grass huts during a season of collecting. This confirms observations in Kenya where the variety was rarely found in human habitations and was shown to be zoophilic (Symes, 1932). On the other hand it is interesting to note that the type form has been found in Mauritius at all hours of the day or night in human dwellings (MacGregor, 1924, cited by Evans, 1938).

*Anopheles (Myzomyia) funestus* Giles.

Larvae were taken in locations which varied from quite shady to exposed areas. Types of breeding places included the edges of swamps, small clear ponds, drainage ditches, irrigation ditches, native wells, temporary rain pools, and the shaded grassy edges of a lake shore. This anopheline seemed about as adaptable to a variety of breeding sites as did *A.*

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*gambiae* and in this respect conditions at Dakar emphasize the principle that generalizations as to the more restricted breeding habits of *funestus* must be viewed with caution (Evans, 1938). In many instances both *funestus* and *gambiae* were found breeding in association.

Adults were collected mainly in native dwellings throughout the year and there were usually more *funestus* than *gambiae* in the huts in total numbers. This species, together with *gambiae*, was one of the most domestic and androphilous mosquitoes encountered. In this connection it is interesting that most adults were consistently taken in grass huts and very few in native houses constructed of wood. This is pertinent to the observation that although it has been recorded as sometimes numerous in European homes in Nigeria, *funestus* is usually much more abundant in native dwellings (Evans, 1938). The darker and more ill-ventilated huts seemed most favored. Certain huts which were used exclusively for cooking purposes and thus were usually filled with smoke, also seemed to attract *funestus* females. It is fairly obvious that the microclimate of the grass hut is its favored haunt at Dakar.

#### *Anopheles (Myzomyia) gambiae* Giles.

Larvae were found in a variety of locations including small pools, drainage ditches, irrigation ditches, the edges of small streams, edges of swamps, temporary rain pools and puddles, stream overflows, sand pools and pits of clear water, shallow wells ranging from several inches to one or two feet deep, and wells of at least five or more feet in depth. These breeding places were nearly always exposed to direct sunlight or at least partially exposed. However, in some cases, such as the deep wells, there was considerable shade. An interesting breeding place was a small pond about ten inches deep filled with turbid and malodorous water of high organic content and covered with an abundant growth of blue-green algae. The *gambiae* larvae were found during March and April in

clear open spaces in breaks of the algal mat. *Culex thalassius* larvae were also breeding in this location and as the culicine population increased the anophelines decreased so that no *gambiae* larvae were in evidence two months later. Whether this was due to competition for food, changes in temperature, increase in the algal mat, or other factors was not determined. Changes in organic content may have been the critical factor since it has been shown that raising the organic content of water by the addition of elephant grass has the effect of replacing anopheline fauna with culicines (Hopkins, 1933, cited by Evans, 1938).

Adult females of this species were taken almost exclusively in native homes. As already stated, *gambiae* ranks with *funestus* as regards domesticity and its preference for human blood. The typical native hut, in which these anophelines were taken, is made of a grass roof and walls, the roof being a pyramid set upon a rectangle or square. The huts varied from about 400 to 1,400 square feet in surface area. The floors were usually sandy, sometimes being covered with a grass mat. Several people commonly lived in a hut which was regularly filled with the smoke of cooking.

Both *A. gambiae* and *A. funestus* were observed to rest at about bed level, where the beds were standard height, and the population thinned out toward the floor. Where the beds were very low, females were found resting near the floor and generally under the bed. Where the ceilings were comparatively low, large numbers of adults were found at the junction of the roof and wall and on cobwebs in corners. Adult females invariably sought places sheltered from the light. Favorite resting places were the folds of native clothing and rags hanging on the walls, tin cans, boxes, and other types of containers with dark interiors. If one disturbed these objects a cloud of anophelines usually came flying out. These observations are similar to those made in Uganda on the habits of *gambiae* in dwellings (Gibbins, 1933).

In cases where natives had placed mosquito nets over their beds most of the *gambiae* and *funestus* in that hut were found resting under them. This was made possible by the prevalent habit of keeping one side of the net folded back during the daytime. It was not determined whether the people made efforts to drive the anophelines from under the nets upon retiring at night. The high incidence of malaria would seem to suggest a negative answer.

Although both species were, generally speaking, negatively phototropic, it should be noted that they were occasionally taken while resting in bright places near holes in the grass wall of the hut with a strong wind blowing directly upon them.

*Anopheles (Myzomyia) pharoensis* Theobald.

Larvae were taken from a small slow stream and a pool formed by a stream. Immature stages were not taken in most of the places observed where adults were occasionally collected.

Adult females were taken in native grass huts and during the period July to December a total of twenty-one were collected. This scarcity of adults in human dwellings seems to confirm observations made at Uganda (Gibbins, 1933). On the other hand, *pharoensis* has been observed to enter houses in large numbers in Egypt and in that region is considered to be a domestic species. Since larvae were seldom collected in or about most of the native villages at Dakar it is possible that the paucity of this species in our collections from human dwellings may have been due to the fact that the villages examined were distant from its breeding grounds (Gibbins, 1933) or that it was to be found outside of the huts because of a predilection for animal blood (Symes, 1932). Some of the native huts in certain villages usually yielded one or more adults quite regularly. This led to the speculation, although it was never proved, that the *pharoensis* adults were emerging out of native wells in these areas. The only other alternative was

that the adults were flying in from considerable distances, but the freshness of the specimens made such an assumption doubtful.

*Ficalbia (Mimomyia) splendens* Theobald.

The only record is of two adult specimens taken in sweepings from heavy grass surrounding a small pond in open country.

*Taeniorhynchus (Coquillettidia) metallicus* Theobald.

Immature stages were not collected. A total of four adults were taken between May and June. Two specimens were collected while resting on the top side of mango leaves and the other two were taken in native grass huts.

*Taeniorhynchus (Mansonioides) africanus* Theobald.

Larval stages were not collected. About forty-nine adults were taken between May and June in native dwellings. Of the specimens taken, many were collected under mosquito nets where they were resting along with large numbers of *Anopheles gambiae* and *A. funestus*.

*Taeniorhynchus (Mansonioides) uniformis* Theobald.

Twenty adults were taken in native grass huts, but this species was not as abundant in human dwellings as *T. africanus*. As in the latter case, many of the adult females were found resting under bed nets in association with the malaria-carrying anophelines. Larvae were not collected.

*Aedes (Mucidus) scatophagoides* Theobald.

Adults were never taken in native dwellings. Of the two specimens collected in August, during the rainy season, both were collected as larvae. One larva was taken from a rain puddle, in turbid water, exposed to sunlight, no vegetation, and filled with tadpoles, minute crustacea, and other aquatic insect larvae. The second specimen was taken from a grassy pool with about two inches of turbid rain-water and exposed to the sun.

*Aedes (Stegomyia) aegypti* Linnaeus.

Larvae were mainly collected from small holes in the trunks of baobab trees. In all cases the water was very clear, about one to three inches deep, and mature larvae were observed in these tree-holes four days after a rainfall. In one instance larvae were taken from a metal barrel exposed to the sun and containing turbid water about six inches deep.

It is interesting that during a year of collecting in native huts of the villages around Dakar no adult specimens of this important species were taken. At the same time there was abundant evidence of its breeding in proximity to these villages during the rainy season. The reasons for this are not clear, although the statement has been made that *aegypti* shows a supposed preference for feeding on Europeans in Africa (Edwards, 1941). Since this species is considered to be highly domestic throughout the Ethiopian region it should also be noted that in Mombasa, British East Africa, *aegypti* was collected by two of the authors several hundred feet from their tent in a shaded grove. It apparently never made an attempt to enter the tents even during the night. Edwards (1941) cites evidence presented by Hopkins that *aegypti*, in Kampala, occurs in European homes and not in native huts.

*Aedes (Stegomyia) metallicus* Edwards.

Considerable numbers of larvae were taken in association with *aegypti* larvae in baobab tree-holes. For the most part these tree-holes contained clear rainwater. In one instance larvae were collected from tree-holes filled with turbid water of high organic content. As in the case of the yellow fever mosquito, no adults were collected in native dwellings.

*Aedes (Aedimorphus) punctothoracis* Theobald.

Larvae were found in small muddy pools surrounded by grass in the shade of palm and mango trees. Adults were taken in sweepings of the surrounding

grass in these shaded groves. Adults were never collected in native huts.

*Aedes (Aedimorphus) irritans* Theobald.

The greatest numbers of immature stages were taken from crab holes in clay soil and in brackish pools. Larvae were also collected in native concrete wells in clear drinking water, about ten feet deep, exposed to the sun and devoid of vegetation. Only two adults were taken in native dwellings throughout the season. A considerable number of adults were collected during the daytime as they rested inside crab holes.

*Aedes (Aedimorphus) ochraceus* Theobald.

Large numbers of larvae were taken during the rainy season in temporary pools containing turbid water and exposed to the sun. Adults were never collected in native huts.

*Culex (Lutzia) tigripes* Grandpré and Charmoy.

Throughout most of the season larvae were taken in irrigation ditches between hills of yams near a native village. The water contained much algal material and was exposed to the sun. *Anopheles gambiae* larvae were also breeding in this location and it is possible that *tigripes* may have been feeding on this anopheline since its breeding places "seem to be limited more by the presence or absence of other larvae on which to prey than by any other factor" (Hopkins, 1936).

During the rainy season larvae were collected in small temporary pools, two or three inches in depth, with grass around the edges and clear water. On one occasion larvae were taken from a small circular pool in a grassy field, the pool being about eight feet in diameter and filled with cat-tails. The water was turbid, high in organic content and quite malodorous. Larvae were also collected in native concrete wells and in sandy water holes in association with anophelines.

The single adult specimen collected was in sweepings from grass located in a shaded grove of palm and mango trees near muddy pools.

*Culex (Culiciomyia) nebulosus* Theobald.

Quite a number of larvae were taken during the rainy period from baobab tree-holes in clear water. These were in association with *Aedes aegypti* and *A. metallicus*. Adults were noted near tree-holes resting on branches, but they were never taken in native huts.

*Culex (Culex) bitaeniorhynchus* Giles.

Larvae were collected in stagnant water in a swamp filled with profuse growth and abundant filamentous green algae, small crustacea such as *Cyclops* sp. and exposed to the sun. Larvae were also taken in irrigation ditches containing profuse algal growth and directly exposed to the sun. Adults were never seen in native huts.

*Culex (Culex) thalassius* Theobald.

Although larvae of this species were taken in diverse locations, most of the material was collected in small ponds about ten inches deep and containing turbid malodorous water. These ponds were exposed to sunlight, grass was quite heavy about the fringes and the water level fluctuated slightly from month to month. There was an abundant growth of blue-green algae and the larvae seemed to gather at breaks in the algal mat. Small crustaceans, syrphid fly larvae and desmids were characteristically in evidence and it has already been mentioned above that larvae of *Anopheles gambiae* were found in this locality during the spring months when the *thalassius* larvae were not yet numerous.

Other breeding sites included temporary rain pools, brackish pools, edges of swamps, and small pools from a stream overflow. In most cases observed the larvae were exposed to the sun and the water was fairly warm. This was especially true of the pools of foul-smelling water noted above. The adaptability of the larvae at Dakar confirms earlier observations on this species elsewhere (Ingram and Macfie, 1917).

Adults were collected in moderate numbers, mainly during May and June, from

native grass huts. During the period in which adults were collected in native dwellings they were among the most numerous of the culicines taken in this location.

*Culex (Culex) tritaeniorhynchus* Giles.

Immature stages of this coastal species were not collected. One adult female specimen was taken in a native hut and several adults were taken in sweepings from shaded grass near a stagnant pool in a wooded region.

*Culex (Culex) duttoni* Theobald.

Although this is considered to be one of the most common species of *Culex* in tropical Africa, very few specimens were collected at Dakar. Larvae were taken in an irrigation ditch in clear water and exposed to the sun; and they were also collected from a shallow sandy water hole, exposed to the sun, with slightly turbid water. *Anopheles gambiae* larvae were in association. Three adult specimens were taken from native huts during the year.

*Culex (Culex) quinquefasciatus* Say.

This was the most domestic species of culicine collected and it was found breeding mainly in the proximity of native villages in a variety of places. Types of breeding locations included the following: polluted drainage water in a drainage pit covered with a concrete slab; baobab tree-holes associated with *Aedes* larvae; in a concrete tank exposed to sunlight with water covered by algae; in metal and wooden barrels containing turbid water; in native wells containing clear drinking water; in temporary rainpools, in puddles, holes, and pits either shaded or exposed to the sun.

Adults were collected throughout the year in native grass huts. Females were in the habit of resting under bed nets and in dark corners and containers along with the two anophelines of importance.

*Culex (Culex) antennatus* Becker.

Larvae were taken in the following locations: stagnant swamp water covered with algae; irrigation ditches between yam

hills in clear water with some algae; small temporary rain pools in clear water; native concrete wells about ten feet deep with clear water; small pools in grassy fields containing turbid foul-smelling water; sandy holes with clear water and exposed to the sun; and in a wooden tank containing clear water. Observations at Dakar are not fully in accord with the statement that larvae of this species usually occur in stagnant water (Hopkins, 1936). Adults were not collected in native dwellings.

*Culex (Culex) decens* Theobald:

The only record of larval collection we have is from a native well in clear water exposed to the sun. Adults were collected in very meager numbers from native grass huts during the spring months.

*Culex (Culex) invidiosus* Theobald.

One larval collection was made during August in a small grassy pool with turbid water of high organic content and exposed to the sun. Adults were not encountered in native homes.

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