MOSQUITOES COLLECTED IN HORSE-BAITED TRAPS IN PANAMA DURING 1951 TO 1953 INCLUSIVE AS AN INDEX TO MALARIA CONTROL [1]

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The control of malaria in Panama has en an important mission since the be-nning of the construction of the Pan-ıa Canal. A great number of papers ve been published on malaria and mos-uito control in this area.

It is the purpose of this paper to report summary of the mosquitoes collected in ›rse-baited traps in and adjacent to Army stallations in Panama. The period vered begins with January 1951 and ds October 31, 1953. The present paper als only with mosquitoes. Such biting iptera as *Culicoides, Phlebotomus,* Tab-idae, and Simuliidae, often taken from ›rse traps, are not considered here.

METHODS. The adult mosquitoes were llected in horse-baited traps of the Egyp-n type as described by Bates (1944). ıese traps were operated four nights ch week throughout the entire period xclusive of holidays) on all Army posts both the Atlantic and Pacific sides of e Canal Zone. The purpose of this is keep an index of mosquito populations ıich should give an indication of the iciency of control measures currently in e.

A horse was placed in each trap late in e afternoon and all insects were re-›ved from the trap and brought to the ›oratory of the 25th Medical Detachment for identification the following morning. This is a continuation of the exact meth-ods employed and described by Carpenter and Peyton (1952).

HISTORY OF ANIMAL BAITED TRAPS. The idea for using horse-baited traps is not new. Since the discovery that anopheline mosquitoes are the vectors of malaria *Plas-modia,* many methods of trapping have been devised for the purpose of recording population trends. Not all types of traps work efficiently for all kinds of mos-quitoes. Goodwin (1942) found barrels to be quite effective. He painted the in-side of these barrels black or red and par-tially sunk them into the hillside or into a natural bank. The aperture was par-tially covered in order to make the interior dark and to exclude some of the wind. Smith used nail kegs and placed them in the underbrush where the area was damp. The senior writer has used the Smith technique for the same species, *Anopheles quadrimaculatus,* at Camp Chaffee, Arkansas. This method is suc-cessful for several species of *Anopheles* but since very little is known about the rest-ing habits of *Anopheles albimanus* it is not useful for the latter species on the military installations in Panama. Russell and Santiago (1934) described an earth-lined box which they used to attract *Anopheles minimus flavirostris* but this trap, which was useful in the Philippines, was useless in Southern India for *Anopheles culicifacies* and they resorted to mud-thatch or all thatched traps baited with a calf.

Kumm and Zúniga (1944) used an animal baited trap to record seasonal vari-ations of *Anopheles albimanus* and *pseu-dopunctipennis* in Costa Rica and El Sal-vador. They used a portable trap which was a modification of the type designed by

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Magoon (1935). Earle and Howard (1936) reported on the use of a permanent type trap in Puerto Rico. Several variations of the type trap and animal bait have been used throughout the world. Most traps are about 4 feet wide, 8 feet long, and 7 feet high. Our traps have doors at each end. A V-shaped slot permits the mosquitoes to enter the trap but they rarely escape. Marston Bates (1944), who experimented extensively with animal traps in Egypt, reported that when the entrance slot was designed to force the mosquitoes to fly downward there were fewer that escaped.

LOCATION OF TRAPS. The writers have operated horse-baited traps at Albrook Field, Fort Clayton, Fort Kobbe, Fort Davis, Fort Gulick, Fort Sherman, Navy Tank Farm, Fort Sherman Reservation, Camaron, Mount Hope Dump Area, Coco Solito, and the middle Chagres. More than one trap was operated on some posts such as Fort Kobbe and Fort Davis. The Fort Sherman Reservation included traps operated at Gatun Tarpon Club, Chagres S & H Road, mouth of Chagres River, Mojinga Swamp, Devils Beach, and Loma Boracho. These all have been lumped together as Fort Sherman Reservation—a very large area and for the most part unsanitated.

HORSE-BAITED TRAPS VERSUS OTHER METHODS. Carpenter and Peyton (1952) report the results of horse-baited traps and light traps run at Madden Dam, Canal Zone, for one year beginning in October 1948. They caught 50 *Anopheles* sp. in New Jersey light traps compared to 1,587 in the horse-baited traps and for all species of mosquitoes 3,391 were taken from light traps as compared to 65,323 from the horse-baited traps. In contrast to this, Pritchard and Pratt (1944) found a light trap to be superior to horse-baited traps for collecting *Anopheles albimanus* in Puerto Rico. During the period of study reported in this paper no direct comparisons have been made and most of the light trap surveys have been in outlying areas.

Simmons (1939) in his table 57 give the total anopheline mosquitoes collecte by hand in barracks, theaters and othe buildings on Army posts in the Can Zone from 1930–1935. He states that th numbers do not represent the total anophe lines present, as catching was done only a a check on mosquito flights. He repor that, in 1933 a total of 8,545 anopheline were caught at 10 Army posts. Thi work was continued and in 1936, 11,40 *Anopheles* were caught. Simmons est mated that this represented about 10 pe cent of the *Anopheles* in buildings, whic would make 114,000 during 1936. Th malaria rate for 1936 was 39.4. The ra increased slightly in 1937 despite th enormous drop in anopheline population This shows that the number of *Anophel* mosquitoes does not always directly affe the malaria rate.

The picture has changed a great de since Simmons' report. The senior writ did not observe a single *Anopheles* mo quito in his quarters at Fort Clayton i over three years, which shows the hig degree of malaria control now in operatio in the Canal Zone.

RESULTS: SPECIES COLLECTED. Sinc malaria vectors were the primary interes and since it is extremely difficult if n impossible to identify all of the female especially *Culex* to species, several of th genera were not separated into specie The following identifications, and th numbers of each species or genus capture constitute the trap records:

Chagasia bathanus 3.

Anopheles: punctimacula 17,960; *albiman* 6,602; *aquasalis,* 6,413; *oswaldoi* 2,685; *apic macula* 2,549; *neomaculipalpis* 1,544; *neivai* 23 *pseudopunctipennis* 27; *squamifemur* 11; *triann latus* 11; *argyritarsis* 10; *anomalophyllis* 9; *eise* 6; *strodei* 6; and *Anopheles* spp. 7.

Trichoprosopon: espini 767; *longipes* 22; *dig tatum* 16; *lampropus* 4; *magnum* 3; and *rapax*

Sabethes: chloropterus 24; *cyaneus* 1.

Wyeomyia spp. 219; *Limatus* spp. 47; *Uran taenia* spp. 2.

Mansonia: titillans 49,306; *fasciolata* 18,10 *nigricans* 1,091; *indubitans* 245; *pseudotitillans*

Aedeomyia squamipennis 18.

Psorophora: cingulata 3,474; *ferox* 670; *luts* 253; *ciliata* 4; *lineata* 1.

Aedes: taeniorhynchus 11,258; *angustivittatus* 4,710; *fulvus* 478; *serratus* 107; *hastatus* 78; *leucocelaenus* 53; *septemstriatus* 27; *clarkii* 22; *terrens* 2; *leucotaeniatus* 1.

Haemogogus: lucifer 357; *equinus* 196; *spegazzinii-falco* 2.

Culex spp. 28,083; *Deinocerites* spp. 2,195.

DISCUSSION. Fourteen of the seventeen genera of mosquitoes known to occur in Panama are represented in the catches from horse-baited traps over a 3-year period. *Orthopodomyia,* rarely found on our military installations, *Toxorhynchites,* a non-biting mosquito, and *Culiseta,* a northern species, are the only three genera missing from the list.

Some of the pest species such as *Mansonia titillans, M. fasciolata, Aedes taeniorhynchus,* and *Culex* occurred in sufficient numbers to be troublesome at times.

On well sanitated posts the *Anopheles albimanus* count was low. It was lowest at Albrook Field, where 7 specimens were trapped in 333 nights for an average of 0.02 *A. albimanus* per night. At France Air Force Base, a post that was reactivated during the course of these studies, it was high for a sanitated post, with 567 specimens caught in 186 nights for an average of 3 *A. albimanus* per trap night. Fort Sherman was high but this is a very large reservation which was reactivated during the course of these studies. It has been deactivated and all sanitary work has been stopped there. At Fort Davis 381 *A. albimanus* were captured in 907 trap nights for an average of 0.4 per night. During the course of these studies Mindi Dairy was expanded and now surrounds Fort Davis on three sides of the post, and since this dairy is outside the army control it is impossible to keep Ft. Davis free of mosquitoes.

In contrast to the mentioned sanitated areas, the upper Chagres River, a few miles above Gamboa, a total of 4,017 *A. albimanus* were captured in 74 nights operation for an average of 54.3 per trap night.

During this period a total of 161,284 specimens were collected from horse-baited traps of which 6.602 were *Anopheles albimanus,* 17,960 *Anopheles punctimacula,* 13,520 other *Anopheles,* and 123,202 pest species.

Of the pest species, *Aedes taeniorhynchus* is the most serious. This species follows heavy flooding of salt marshes after peak tides and heavy rainfall. There is usually one peak emergence at Fort Kobbe each year followed by one or more minor flights. Several species of the *Mansonia* group, especially *M. titillans* and *fasciolata,* are troublesome at times on some military installations.

SUMMARY. Horse-baited traps have been operated on most of our Army posts during the past three years in order to maintain a constant picture of the mosquito population and to check on the efficacy of control measures. A total of 4,478 trap nights resulted in the capture of 161,284 mosquitoes. Of those, 6,602 were *Anopheles albimanus,* 17,960 *An. punctimacula* and 13,520 were *Anopheles* of other species and 123,202 were pest species.

The population of *Anopheles albimanus* was lowest at Albrook Field, a well sanitated post, with an average of 0.02 specimens per trap night. This, compared to the number collected in the Middle Chagres, an unsanitated area with an average of 54.3 *A. albimanus* per trap night, shows the potential breeding when control methods are not used.

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THE SPREAD OF *AEDES SOLLICITANS* (WALKER) IN KENTUCKY

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Aedes sollicitans (Walk.), the salt-marsh mosquito, is now established in Hopkins and Henderson Counties, Kentucky. Complaints of mosquitoes in Madisonville (Hopkins County) led to the collection of five female adults on May 27, 1954. They were found to be *Aedes sollicitans* (Walk.). On June 22, 1954 in the course of a mosquito control program by the City of Henderson and the Henderson County Health Department ten females were collected in Henderson. The following day numerous pupal exuviae and adults were seen at Smith Mills (Henderson County), located about eleven miles west of Henderson; but no larvae were found. Numerous larvae, however, were found at this site on October 5, 1954, breeding in a swamp polluted by salt from oil wells. On June 24, 1954, twenty larvae were collected at Richland, about three miles from Madisonville, breeding in coal-mine polluted water which had overflowed, forming a pool beside a creek. Dr. Alan Stone, of the U. S. Department of Agriculture, has confirmed the identification. Four adult females and six larvae have been deposited in the U. S. National Museum.

A check through the files of mosquito records at the Kentucky State Department of Health showed that on July 4 and 5, 1946, Dr. Frank W. Fisk and Mr. James H. Crawford, then employed by CDC, U. S. Public Health Service, collected 35 females by hand and 9 females by New Jersey light trap at Smith Mills. Their record, however, was unpublished. Blakeslee and Payne (1953) reported one female collected by light trap on June 6, 1953, at Fort Knox (Hardin County).

The finding of this species in the Western Coal Field shows that since 1946 this species has spread at least thirty miles south of Henderson and is breeding in sufficient numbers in mine-polluted water to cause a problem in mosquito control.

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