

## ARTICLES

NOTES ON THE NEOTROPICAL *ANOPHELINAE* IN  
MOENGO, SURINAM

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The several species of *Anopheles* which occur in the tropical forests of the Guianas are the cause of considerable malaria. Every settlement within these forests must consider the danger of this disease. In fact, the efficiency of the sanitary measures undertaken for controlling malaria is responsible for the success or failure of the industry wishing to colonize.

In Dutch Guiana, or Surinam, the village of Moengo, with a population of about 1500, is 130 miles east of Paramaribo in the bush of the upper Cottica River. It was developed by the Surinaamische Bauxite Maatschaap in 1920, for the personnel employed in the bauxite mine. Since its beginning Moengo has grown steadily and now represents a veritable island of civilization deep in dense virgin jungle.

Since 1920 several malaria epidemics have been suffered by the population. Persistent malaria control measures however have reduced the infection until today practically no malaria occurs.

Badly infected Bushnegro and Indian villages nearby form a constant threat to Moengo and for this reason a constant mosquito control and survey as well as a medical inspection of the inhabitants of Moengo and the surrounding villages is desirable.

In August 1944, Dr. I. Guischerit, physician of the hospital in Moengo, sent me some Anophelinae for determination. I was much surprised to find in the collection not the common *Anopheles aquasalis*, nor *A. darlingi*, the widespread malaria carrier in the interior, but a rare mosquito *Anopheles pessoai*, which seems to be new

to this country. Encouraged by this finding, we both became more interested in the Anophelinae population of Moengo and several collections followed. Besides additional specimens of *A. pessoai*, individuals of *Anopheles aquasalis* and *A. oswaldoi* were also received. In spite of a careful search for *Anopheles darlingi*, especially in the Bushnegro villages in the bush around Moengo, not one could be found. A person especially trained in mosquito catching did not find a single Anopheline mosquito after a visit of six days and nights in one of these villages.

One week previous to this search for Anophelines Dr. Guischerit took 71 blood smears in the same village. Of these 48 per cent were infected with *Plasmodium*. The infection among the children, less than 12 years old, was 55 per cent. These data show clearly that a dangerous malaria carrier is present.

During a visit to Moengo early in May 1945, Dr. Guischerit and I planned a systematic program for catching mosquitoes for the purpose of recording the present species of *Anopheles*, to locate their breeding places, and to recognize their relationship with the seasons. Especially, we noted the relationship of rainfall to their abundance.

Since there is little known about the ecological relationships of neotropical Anophelinae, it appeared appropriate to publish these notes although the observations are far from complete. Moreover these observations will form an introduction to the systematic mosquito-trap records, which H. H. Stage, entomologist of the Bureau of Entomology and Plant

Quarantine, Washington, D. C., arranged during his experiments in Moengo with water-dispersible DDT in March and April 1946.

### *Anopheles* Hitherto Recorded

In the samples identified between August 1944 and March 1946, seven species of *Anopheles* were represented. These are *Anopheles aquasalis*, *A. oswaldoi*, *A. pessoai*, *A. apicimacula*, *A. mediopunctatus*, *A. shannoni*, and *A. peryassui*. *A. pessoai* and *A. shannoni* have not been found before in Surinam, but are recorded from Venezuela, Colombia and Brazil and the latter also from British Guiana. Their occurrence in Surinam is not surprising; but it is noteworthy that *A. pessoai* is now the most abundant Anopheline in Moengo, and that *A. oswaldoi* and *A. aquasalis* are also common. The other species appear only seldom.

In the earlier reports of the Anopheline records of Moengo by Dr. Bonne and his wife Dr. Bonne-Wepster and given in their book "Mosquitoes of Surinam" (1925) we find a remarkable difference from the present fauna. These workers announce the following species from Moengo; *Anopheles nimbus*, *A. eiseni*, *A. "tarsimaculata"* (= *aquasalis* and *oswaldoi*), *A. intermedius*, *A. argyritarsis* (= *darlingi*, of which is noted: "At Moengo we found them breeding several times in swampy places with many

algae."), *A. peryassui* and *Chagasia fayardi*.

With the exception of *A. peryassui* and *A. "tarsimaculata"* none of these species have been collected by us. This difference is interesting for it no doubt is indicative of the greatly changed environment during the last 20 years. The bush, or virgin jungle, is cleared for a distance of a mile or more from the center of Moengo. After the bauxite hills were opened, pools filled with rainwater and remained in the old minefields. The water in these pools is highly aluminous making them unfavorable as a breeding place for the original mosquito species but perhaps favorable for others.

In the lower places adjacent to the banks of the Cottica River, a polderland on which cattle graze has been formed. This sunny lowland meadow also presents very different conditions from the densely shaded virginal jungle. Eastward on the road to Albina for a distance of a mile or so a settlement of Javanese laborers sprung up with the result that the original jungle swamps are now replaced by rice fields.

### *Distribution of the Species and Their Relation to Malaria*

Most of the collecting was done in 10 places distributed over the area of Moengo from west to east. They are indicated in Table 1, together with the collected species of *Anopheles*, as follows:

TABLE 1

<i>Anopheles</i>	Old Tank Yard	Dynamite Houses	Old Mine	Athletic Field	Market	Village Houses	Farm	Incinerator	New Mine	Railroad East of Moengo
<i>apicimacula</i>	x		x			x	x			x
<i>aquasalis</i>	x	x	x	x	x	x	x		x	x
<i>oswaldoi</i>	x	x	x	x	x	x	x	x	x	x
<i>pessoai</i>	x	x	x	x	x	x	x	x	x	x
<i>mediopunctatus</i>	x	x	x		x		x	x	x	x
<i>peryassui</i>	x				x		x			
<i>shannoni</i>					x					

From this table we see that six of the seven Anophelines are found at the Oil Tank Yard, the Farm and on the railroad to Rikanau Hill, east of Moengo. These areas are situated on the outskirts of the cleared area, which means that they are not far away from the original jungle forest and are probably under the influence of the original mosquito fauna.

The other areas, especially the village, show a smaller number of species. This may be the result of unfavorable environment to the bush-loving Anophelines. The most common species in the village is *A. pessoai*, which up until now has been represented only by females. Its breeding places have not yet been located.

*A. oswaldoi* and *A. aquasalis* are found distributed over the Moengo area especially in the weed-covering open spaces outside the village.

The other species such as *A. apicimacula*, *A. mediopunctatus*, *A. peryassui*

and *A. shannoni* appear only occasionally. Since they have been found mostly in the edges of the cleared area, they no doubt come from the surrounding jungle.

From a practical point of view it is important to know the relation of the species of *Anopheles* to malaria. However, it is difficult to get complete information regarding their efficiency as carriers of the disease. Attention may be called to the fact that in an infected region, malaria decreases with the clearing of the bush. This probably means that the breeding places are changed ecologically hence the development of the dangerous species no longer exists. As long as the area is within the reach of the Anopheline the inhabitants of that place will still exhibit malaria. When the jungle is cleared from an area larger than the normal flight range of the carrier, malaria will disappear. This does not mean that the Anophelines will not be present but it

TABLE 2. Number of Anophelines Collected by Months.

	Rainfall in mm.	* Average rainfall	<i>A. aquasalis</i>	<i>A. oswaldoi</i>	<i>A. pessoai</i>	<i>A. apicimacula</i>	<i>A. mediopunctatus</i>	<i>A. peryassui</i>	<i>A. shannoni</i>	Total number
1945										
Apr.	166	(262)	10 ♀			1 ♀ 1 ♂				11 ♀ 1 ♂
May	350	(363)	7 ♀		41 ♀	2 ♀				50 ♀
June	282	(292)	27 ♀ 2 ♂	1 ♀	111 ♀		1 ♀			140 ♀ 2 ♂
July	225	(267)	75 ♀ 3 ♂		268 ♀		4 ♀	3 ♀	1 ♀	351 ♀ 3 ♂
Aug.	192	(152)	11 ♀		17 ♀					28 ♀
Sept.	30	(69)	11 ♀	87 ♀ 4 ♂	2 ♀	1 ♂	1 ♂			100 ♀ 6 ♂
Oct.	89	(68)	25 ♀	128 ♀ 9 ♂	6 ♀	1 ♂	2 ♀			161 ♀ 10 ♂
Nov.	135	(121)		38 ♀ 1 ♂	15 ♀		2 ♀	1 ♀		56 ♀ 1 ♂
Dec.	411	(255)	10 ♀	38 ♀	10 ♀	3 ♀	2 ♀			63 ♀
1946										
Jan.	267	(228)	21 ♀	10 ♀	7 ♀	1 ♀		1 ♀		40 ♀
Feb.	71	(112)	23 ♀	50 ♀	25 ♀	3 ♀				101 ♀
March	149	(158)	3 ♀	85 ♀	40 ♀		1 ♀	1 ♀		130 ♀

\* Braak, 1935.

does mean that those species living and breeding in the open area, are generally harmless. We must consider, however, that in this case we are not fully informed about most of them. Of the species under consideration, the following data are given in Russell, Rozeboom and Alan Stone 1943, Bonne & Bonne-Wepster 1925.

<i>Anopheles</i>	Relation to malaria
<i>aquasalis</i>	An important vector in many localities. "We could infect ( <i>tarsimaculata</i> ) in Paramaribo with malarial parasites without any difficulty" (Bonne & Bonne-Wepster, p. 515).
<i>oswaldoi</i>	Not determined
<i>pessoai</i>	Unknown
<i>apicimacula</i>	Data inadequate
<i>mediopunctatus</i>	Unknown
<i>shannoni</i>	Unknown

From this list we see that *A. aquasalis* is a dangerous species. Of the other species, however, our knowledge is too incomplete to determine their role as transmitters of malaria.

#### Dependence of the Species on Rainfall

One of the main factors in the tropics to which the mosquito population reacts,

is rainfall. In Surinam the principal rainy season is from May until August and there is a corresponding dry season from September through November. A short rainy season exists from December to February. This is followed by a short dry season from February through March. The heavy rainy season and the principal dry season are fairly constant but the shorter seasons are irregular.

The average rainfall for the year in Moengo amounts to 2400 mm. (100 inches), and is shown by months in Table 2. Also in this table the total number of each species is recorded for each month.

It is evident from these data that *A. aquasalis*, *A. oswaldoi*, and *A. pessoai* are dominant while the other ones although represented almost monthly were collected only in very small numbers. Because of the few individuals collected, we do not attempt an interpretation of their importance. Of the three species *A. pessoai* is the most numerous, second in importance is *A. oswaldoi*, while *A. aquasalis* appears regularly although in moderation.

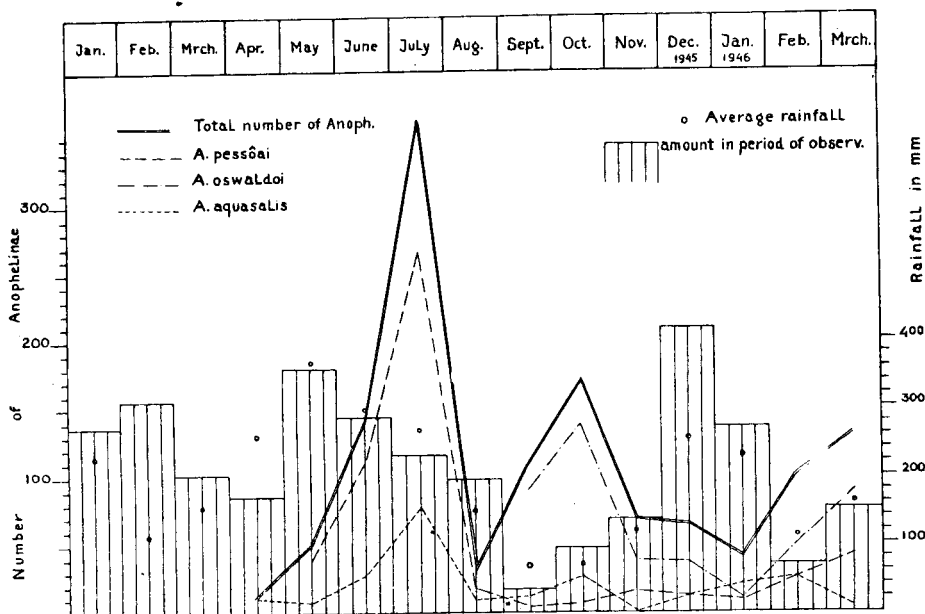


FIG. 1. Relation of precipitation to seasonal abundance of Anopheline species observed.

*A. aquasalis* and *A. pessoai* are most abundant in July. *A. oswaldoi* is most numerous in October, and slightly less so in March. This means the *A. aquasalis* and *A. pessoai* are dependent on the big rainy season, but that *A. oswaldoi* is prevalent in the dry season. Insofar as our information goes, it seems also that the other species are dependent on the rainy seasons.

When we consider the total anopheline population in the different months of the year, it becomes evident that there are three maxima: the largest one in July, in the middle of the big rainy season; the second one in October, in the middle of the dry season; and the third one in March in the middle of the short dry season.

The observations are best demonstrated graphically, Fig. 1. The influence of the rainfall on the presence of *A. pessoai* and of *A. aquasalis* is clear. The presence of *A. oswaldoi* in the dry seasons is also evident. The curve clearly demonstrates that the peak in July is due mainly to *A. pessoai* and to a less extent by *A. aquasalis*, but that the other two peaks in October and March, are caused by *A. oswaldoi*.

From these data we may conclude, that of the seven species of *Anopheles* found in Moengo, only three appear dominant as follows: *A. pessoai*, *A. oswaldoi*, *A. aquasalis*. Among these species we recognize two as reaching their peaks in the big rainy season (July), whereas only one dominates in the dry season (October, March).

Since the above information was obtained extensive collections of mosquitoes were made possible by the use of new traps imported by H. H. Stage, in connection with a study of the mosquito population before and after treatment with a water dispersible DDT. These data will no doubt increase our knowledge on the seasonal abundance of these species.

#### Summary

1. The jungle surrounding Moengo, Surinam, is inhabited by seven species of *Anopheles* some of which are dangerous

carriers of malaria. They are a constant threat to every settlement in the interior.

2. Records made twenty-five years ago, however, show that five other species were found. These include the dangerous *A. darlingi*, which is now superseded by the dominant *A. pessoai*, not previously known in Surinam.

3. The differences are probably the result of ecological changes caused by the mining of bauxite and the clearing of jungle over a large area.

4. The dominant species today are *A. pessoai*, *A. oswaldoi* and *A. aquasalis* and they seem to breed in ricefields, pools in the mining fields, and the ditches around the village which did not exist 25 years ago.

5. The dependence of these dominant species upon the rainfall was demonstrated by a correlation of the abundance of the species with the total amount of rainfall in Moengo. In this respect *A. pessoai*, and *A. aquasalis* proved to be directly influenced, whereas *A. oswaldoi* is most abundant during the dry season.

#### Resumen

1. En la maraña que rodea Moengo, Guyana holandesa, viven siete especie del género *Anopheles*, algunas de las cuales son transmisores peligrosos del paludismo. Son una amenaza continua a cada poblado en el interior del país.

2. Datos de hace veinticinco (25) años, muestran, sin embargo, que se encontró otro cinco especie. Entre éstas es la peligrosa *A. darlingi*, que la dominante *A. pessoai*, antes ignota en la Guyana holandesa, ahora reemplaza.

3. Las diferencias son probablemente a causa de cambios ecológicos producidos por la minería de la bauxita y la enorme aclaración de la manaña.

4. Las especie dominantes hoy día son *A. pessoai*, *A. oswaldoi*, y *A. aquasalis*, y parece que multiplican en campos de arroz, hoyos en los campos de mina, y en zanzas en el pueblo que no existían hace veinticinco (25) años.

5. El apoyo de estas especie dominantes al aguacero se mostró por una correlación

de la abundancia de la especie con todo el aguacero en Moengo. En cuanto a esto, se probó que *A. pessoai* y *A. aquasalis* están influidas directamente, mientras que *A. oswaldoi* es el más abundante durante la estación seca.

(Author's English summary translated into Spanish by Mr. Clark Collins through the courtesy of Miss Helen Sollers.)

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