WORLD HEALTH ORGANIZATION
ORGANISATION MONDIALE DE LA SANTÉ

WHO/VBC/71.279
ORIGINAL: FRENCH

SURVEYS OF POTENTIAL YELLOW FEVER VECTORS IN GABON AND CHAD (21 October - 7 November 1970)

by

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1. AIMS

Little is known regarding the distribution and ecology of the Culicinae especially of potential yellow fever vectors in Gabon and Chad, whereas information is relatively more plentiful concerning the other States belonging to the OCEAC, namely Cameroon, the C.A.R. and Congo. Consequently the author took advantage of a stay of two weeks in Gabon to study the ecological conditions and quantitative distribution of A. aegypti in the north-west of the country. During three days spent in Chad, similar studies were restricted to a few villages in the neighbourhood of Fort Lamy. At the same time, certain data were collected on culicid fauna in Gabon.

In addition, seven A. aegypti strains were collected in Gabon for laboratory breeding and subsequent investigation of their susceptibility to insecticides, an essential guide in any control campaign.

This research was motivated by the concern of OCEAC, which has been aroused by the recrudescence of yellow fever in Africa and was therefore welcomed by the authorities of that Organization, which is endeavouring to promote a rational prophylaxis of the endemic in the Member States.

2. SURVEYS IN GABON

2.1 Epidemiological and entomological background

Memories of the devastating yellow fever epidemics are still vivid in the coastal region of Gabon, but no case of the disease has been reported since 1949. An OCEAC information document (June 1970) mentions the presence of antibody in a few unvaccinated subjects and does exclude the possibility of jungle transmission in the east of the country.

The list of mosquitos in Gabon (Annex 1) has been drawn up on the basis of the work of Edwards, Galliard, Grjebine, Lacan and De Meillon. Although it is fairly extensive as regards the vector mosquitos of malaria, it is still very brief as regards the culicinae and especially Aedes, the potential yellow fever vectors. In view of the richness in species of the neighbouring forest areas, it is clear that there are enormous gaps in our knowledge of the entomological fauna of Gabon. Moreover, the fact that certain species which are plentiful everywhere in the forest, such as Erematpodites chrysogaster, have not been previously reported is rather significant of this state of affairs.

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2.2 Organization of the surveys

An attempt was made to visit as many localities as possible in the time available, i.e. 12 days. For this purpose it was necessary to give preference to towns and villages situated on main roads accessible at that period of the year (12 localities in west Gabon). As a consequence, villages isolated in the bush away from roads passable by vehicles could not be reached.

The author had at his disposal a team limited to a sanitation technician and two operators, personnel kindly made available by the Libreville Urban Hygiene Service. Activities were centred on the search for larval breeding places, omitting captures of adult mosquitos, despite their value, because of lack of time and especially of trained personnel.

In each locality a certain number of houses and their surroundings were visited; they were chosen in different neighbourhoods so as to obtain a representative sample. In very small hamlets all dwellings were examined. In addition, samples were taken in garages (tyres), stores of equipment and materials (old iron), and natural breeding places (tree-holes, the axils of plants with ensheathing leaves).

The specimens of larvae collected were bred in an improvised laboratory for rapid classification of the adults or in order to obtain egg batches. Surplus specimens preserved in alcohol were classified later on, especially Culex.

2.3 Situation as regards Aedes aegypti L.

West central Gabon is under the influence of an equatorial climate with four seasons. The rainfall, which is greater than 2000 mm, is spread over two rainy seasons while there are also two shorter dry seasons. The vegetation is of the equatorial forest type, and thins out to some extent around villages and forestry work-sites.

This survey took place at the beginning of the rainy season (late that year). It was raining hard everywhere except at Port Gentil, where the dry season still continued.

Table I summarizes the captures made and shows the presence of A. aegypti in all the villages visited except one which was recently built (Oyan IV). However it cannot be concluded that this mosquito is present in all the villages of west Gabon since villages in the bush away from tracks passable by motor vehicles were not reached. But, as will be shown later on, it is precisely in such villages that the species might be absent.

In the towns and villages of the Gabonese forest, A. aegypti is a peridomestic insect but not a domestic one. Hardly any larvae are found in stores of water inside dwellings since they are small and frequently renewed. On the other hand, larvae are not uncommon in drums placed outside dwellings to collect rain water from the roof and store it for domestic use. Such containers even constituted the few rare breeding places at Port Gentil. In general, discarded containers outdoors (cans and various receptacles, old tyres, scrap iron, etc.) comprise the main A. aegypti breeding places in Gabon. This waste of industrial civilization accumulates behind the houses; its volume depends on the purchasing power of the population but is inversely porportional to the activities of the garbage clearance services. Larvae were found only once in a natural biotope (tree-holes).

Quantitative evaluation of A. aegypti populations using the house index is difficult since the larvae are practically always found outdoors. The container index (percentage of containers holding larvae) is more revealing, but it is the Breteau index (number of breeding places per 100 houses) in particular which seems most representative. The Breteau index which is 43 for the Libreville built-up area was generally more than 20 in the localities visited, except at Port Gentil where the climatic conditions were exceptional for the season.

The situation as regards A. aegypti in the forest area of Gabon is comparable to that observed in the Ivory Coast, where that mosquito is plentiful in the towns, forest camps and areas with an industrial income. Nevertheless, a true picture of the situation would necessitate the survey of villages further away from the towns and industrial areas, a programme which could not be carried out because of lack of time.

The A. aegypti strains collected all bite man very readily but no information exists as concerns their aggressiveness towards that host under natural conditions. The author was able to observe only that the females entered houses and bit severely at dusk in Libreville.

The observation of the presence of A. aegypti larvae in drums holding water at the end of the dry season at Port Gentil would seem to show that the species exists throughout the year in both the larval and adult states, since this type of breeding place is permanently present in all the localities surveyed.

2.4 Other potential vectors in Gabon

Among the other potential yellow fever vectors only Aedes simpsoni was known in Gabon; its larvae were found at Oyan in one of their preferred biotopes, namely the axils of banana tree leaves. In addition Aedes africanus was found in cut bamboo at Cape Esterias. These are common species which must certainly exist all over the country.

Another experimental yellow fever vector is very plentiful in Gabon, namely Eretmapodites chrysogaster. Its larvae, or those of other species of this group, are constantly found in containers thrown away in the undergrowth around villages.

However, there is no information concerning the density, aggressiveness and anthropophily of these mosquitos in Gabon. This is a task calling for a trained team, which was not at the author's disposal.

2.5 Epidemiological considerations

Although there have for long been no epidemics, the area of west central Gabon surveyed should be regarded as epidemiologically dangerous because of the high A. aegypti density, for

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greater than 10 which is the case here. It follows that vaccination is necessary all over this area.

A mosquito control programme is under way in Libreville. Because of the resistance of Culex fatigans to DDT and dieldrin and the possibility of Anopheles gambiae being resistant, the chlorinated insecticides will be replaced by organophosphorus ones (fenthion, Dursban and Abate) as larvicides and by a carbamate (propoxur) as imagocide. This choice of insecticides is a very judicious one. The author discussed the organization of the campaign at length with the Chief of the Urban Hygiene Service, for it involves certain problems. This urban disinsection programme should have a definite effect on A. aegypti populations, the changes in which during the operations would, moreover, be very interesting to follow up.

2.7 Resistance to insecticides

Seven A. aegypti strains are at present being bred in order to study their susceptibility to insecticides. They come from Libreville, Port Gentil, Ntoum, Meba, Ndjole, Cape Esterias, and Bifoun. They will be tested against DDT, dieldrin, HCH, malathion, fenthion, Abate, Bromophos, OMS 437, Dursban and fenitrothion.

The multiplication of the strains will call for several generations and tests cannot be made before three months. The results will be communicated to the bodies concerned.

3. SURVEYS IN CHAD

GRJEBINE[1] (1958) reported A. aegypti at Fort Lamy but during a rapid survey in 1960 the author did not find that mosquito. At his request other colleagues, Drs GARIOU and GRUVEL, tried in vain to obtain strains of the insect. Dr Gruvel used the ovitrap method around Farcha without success. Moreover in the course of a recent mission, in August 1970, Mr MORCOS, WHO entomologist did not encounter A. aegypti, neither in adults captured with pyrethrum indoors nor in searches made for larvae in water jars. In the hope of obtaining more information the author spent three days in Fort Lamy from 4-7 November.

Because of a series of misunderstandings it was not possible to carry out the programme planned and activities had to be restricted to visiting two villages; Farcha, on the outskirts of Fort Lamy, and Meskine, 15 km to the north of that town. At that time of the year, at the beginning of the dry season, there were no longer any potential breeding places so that the survey covered water jars. In each house there are one or two jars ("Burma" type) holding 20 to 30 litres, which remain indoors and are filled with buckets of well-water or river water. But these jars are very clean and are frequently washed out. Consequently not a single mosquito larva was found in 32 jars examined in 30 houses of Farcha or in 48 jars in 42 houses of Meskine.

These negative results confirm the rarity of A. aegypti in the Fort Lamy area, at least in the dry season. Only specific investigations during the whole year could supply a satisfactory answer concerning the presence and possibly the life cycle and density of this mosquito in the region.

There has never been a yellow fever case in Chad. This situation is exceptional enough in Africa to warrant an attempt to determine its causes. The rarety of the vectors might be one of them.

At a time when the health service is preparing to launch a yellow fever vaccination campaign, it is essential to know the distribution and frequency of A. aegypti and other potential yellow fever vectors in Chad, for certain areas might be free of them. This is of course, rather long-term work and should be carried out during the rainy season; it calls,

[1] The following culicine species were reported at Fort Lamy by GRJEBINE: Mansonia uniformis, M. africana, Aedes aegypti, Culex tigripes, C. nebulosus, C. pipiens fatigans, C. perfuscus.

moreover, for a specialized team, but forms part of the preparations for a yellow fever prevention plan. It is in fact, not impossible that vaccination may be unnecessary in some regions which are completely free from vectors.

ACKNOWLEDGEMENTS

The author would like to thank all those persons whose assistance made this mission possible. He was warmly welcomed and provided with all facilities for his work by the Director of the Health Service and the Inspector of the Major Endemic Diseases Service of Gabon. Dr RENDERS, Chief of the Libreville Urban Hygiene Service made available one technical sanitation agent and two operators, whose invaluable assistance made it possible to carry out a heavy programme. Drs MARHIC at Port Gentil and GARDET at Ndjole helped in the survey of those localities.

The author's colleagues, Messrs MARTIN and AUDRY, Chiefs of the ORSTOM Centres at Libreville and Fort Lamy, respectively, gave all necessary logistic support, while Mr CHANUT at Libreville was kind enough to take over the mosquito colonies after the author's departure. Dr GRUVEL, I.E.M.V.P.T. entomologist, helped in making the surveys in Chad. Dr GATEFF of the OCEAC and Dr TACHON, Chief of the Major Endemic Disease Service, Chad, furnished all necessary epidemiological information.

TABLE 1. QUANTITATIVE RESULTS OF AEDES AEGYPTI SURVEYS IN GABON

Locality	Position		No. of houses visited	No. of houses positive indoors	No. of peridomestic breeding places	No. positive	Containers index	Breteau index
	Lat.	Long.						
Nombakélé			60	0	100	42	42	70
Mont Bouet			26	0	32	7	22	27
Petit Paris			25	0	16	4	25	16
Glass			15	0	20	1	5	7
Lalala			20	0	28	11	39	55
Louis			30	0	44	10	22	33
Total for Libreville	0.23 N	9.27 E	176	0	240	75	31	43
Cap Esterias	0.35 N	9.20 E	38	0	150	63	42	165
Ntoum	0.22 N	9.45 E	24	0	56	12	21	50
Meba	0.27 N	9.45 E	9	0	24	2	8	22
Amden	0.22 N	9.56 E	13	0	18	3	16	23
Ndjole	0.12 S	10.47 E	30	0	230	90	39	300
Aniera	0.12 S	10.44 E	7	0	6	2	33	28
Lambaréné	0.42 S	10.13 E	25	0	28	5	18	20
Bifoun	0.15 S	10.23 E	10	0	30	4	13	40
Oyan	0.02 N	10.17 E	6	0	0	0	0	0
Avémé	0.04 N	10.13 E	10	0	9	4	44	40
Port Gentil	0.40 S	8.50 E	60	0	33	3	9	5

TABLE 2. CULICIDS CAPTURED IN GABON

Locality	Species	Larvae	Adults
Libreville	Anopheles coustani		+
	An. gambiae		+
	Culex tigripes	+	
	C. nebulosus	+	
	C. pipiens fatigans	+	+
	C. thalassius		+
	C. univittatus	+	
	C. duttoni	+	
	C. gr. decens	+	
	Aedes aegypti	+	+
Cap Esteria	Aedes aegypti	+	
	Ae. africanus	+	
	Eretmapodites gr. chrysogaster	+	
	C. rubinotus	+	
	C. gr. decens	+	
Ntoum	Aedes aegypti	+	
	Ae. apicoargenteus	+	+
	C. gr. decens	+	
Meba	Aedes aegypti	+	
	E. gr. chrysogaster	+	
Amden	Ae. aegypti	+	
	C. nebulosus	+	
	C. tigripes	+	
Kango	Ae. aegypti	+	
Avémé	Ae. aegypti	+	

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3. [redacted]

ANNEX 1

LIST OF CULICID SPECIES IN GABON

1. Anophelines

A. coustani Laveran, everywhere
A. ziemanni Grunberg, Libreville area
A. obscurus (Grunberg), Oyem
A. smithii Theobald, in Gillies and de Meillon, no details
A. cinctus (Newstead and Carter), Oyem
A. nili Theobald, Booué and in the centre of the country
A. moucheti Evans. All the forested centre of the country. Oyem, Mékambo, Makokou, Booué
A. funestus Giles, Libreville, Port Gentil, Tchibanga, Mouila, Ndendé
A. marshallii Theobald, Booué
A. hancocki Edwards, Libreville
A. hargreavesi Evans, Omboué
A. wellcomei Theobald, Libreville
A. gambiae Giles, everywhere in Gabon and particularly abundant in Libreville (very probably "A" species)
A. melas Theobald, Libreville
A. rufipes Gough, Libreville
A. pharoensis Theobald, Libreville, Omboué

2. Culicines

Toxorhynchites brevipalpis Theobald (in Edwards)
Uranotaenia pallidocephala Theobald, Port Gentil (Galliard)
Uranotaenia fusca Theobald (= Ur. inornata Theo.) Banks of the Ofoubou (Galliard)
Uranotaenia ornata[1] Theobald, Oyan
Ficalbia malfeyti (Newstead), Fernan Vaz (Galliard)
Ficalbia minomyiaformis (Newstead), Port Gentil (Galliard)
Aedomyia africana Neveu Lemaire, Fernan Vaz (Galliard)
Mansonia uniformis Theobald, everywhere (Galliard)
Mansonia africana Theobald, Libreville (Grjebine) and almost everywhere (Galliard)
Mansonia aurites Theobald, Fernan Vaz (Galliard)
Theobaldia fraseri Edwards (in Edwards)
Eremapodites chrysogaster[1] (Graham), Cape Esterias, Meba, Ntoum, Njole, Lambaréné
Aedes (Stegomyia) aegypti L. is found almost everywhere, as already noted by Galliard but under the name of A. argenteus Poiret, synonym for the preceding.
Aedes (St.) simpsoni Theobald. Mayumba, Tchibanga (Galliard), Oyan
Aedes (St.) africanus[1] (Theobald). Cap Esterias
Aedes (St.) apicoargenteus[1] (Theobald), Ntoum
Aedes (Aedimorphus) domesticus (Theobald), Fernan Vaz
Aedes (A.) fowleri (Chermoy) = (nigeriensis Theobald) Eschiras (Galliard)

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Aedes (A.) nigricephalus (Theobald). Port Gentil (Galliard)

Aedes (A.) punctothoracis (Theobald), Mayumba (Galliard)

Annex 1

Culex (Lutzia) tigripes (Charmoy), in practically all the localities surveyed
Culex (Neoculex) rima Theobald, Port Gentil (Galliard)
Culex (Neoculex) galliardi Edwards, Port Gentil (Galliard)
Culex (Neoculex) rubinotus Theobald, larvae assigned to this species and coming from Cape Esterias
Culex (Mochtogenes) inconspicuosus (Theobald) = (nyangae Galliard 1931), Tchibanga

Culex (Culiciomyia) nebulosus Theobald, Libreville, Lambaréné, Port Gentil, Nayumba and probably in most of the built-up areas
Culex (Culex) bitaeniorhynchus Giles, Agouma, Mokabo (Galliard). The variety mayumbae has been reported from Tchibanga
Culex duttoni Theobald, Port Gentil, Tchibanga, Libreville, probably in most of the towns
Culex univittatus Theobald. Port Gentil, Mourindi (Galliard), Libreville
Culex invidiosus Theobald. Tchibanga, Eschiras, Fernan Vaz, Port Gentil, Mokabo, Mayumba (Galliard)
Culex quiarti Blanchard, Fernan Vaz (Galliard)
Culex pipiens fatigans[1] Wiedemann. Was not reported either by Galliard nor by Grjebine. Nevertheless very abundant in Libreville and Port Gentil. It is possible that it has multiplied only recently, as in many African towns.
Culex perfuscus Edwards. Eschiras, Agouma, Mokabo, Kroussou (Galliard)
C. perfidiosus Edwards. Mokabo, Rimbo N'Kumi (Galliard)
C. pruina Theobald. Tchibanga, Fernan Vaz. The variety eschirasi Galliard has been reported from Eschiras
Culex thalassius[1] Theobald. Very aggressive in Libreville even indoors
Culex group decens, many larvae belonging to this group were collected all along our itinerary

[1] Species observed in Gabon for the first time.