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GORGAS MEMORIAL LAB PALBOA HEIGHTS CANAL ZONE

ASSESSMENT OF THE BIOHAZARDS OF THE BLACKFLY PROBLEM IN NORTHEA--ETC(U)
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Assessment of the Biohazards of the Blackfly Problem in
Northeastern Panama, Including Possible Presence of Onchocerciasis

FINAL REPORT

January 1978

(for the period 1 April 1976 to 30 September 1976)

by

Pedro Galindo, MS.

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US Army Medical Research and Development Command
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Gorgas Memorial Laboratory
Balboa Heights, Canal Zone, Panama

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A study to investigate a serious blackfly problem in eastern Panama was conducted during the period 1 April 1976 to 30 September 1976. Following is a summary of the findings: (a) Intense blackfly activity in eastern Panama took place inside a belt in the watershed of the Bayano, Chucunaque and Sabanas rivers in eastern Panama and in Darien province. (b) The only species of blackfly collected biting man in numbers was <u>Simulium sanguineum</u> .		

20. Abstract (Cont.)

(c) Biting activity was very local probably due to short flight range of important species, thus leaving many areas within the belt free of blackflies. (d) Biting activity was restricted to the rainy season reaching a peak in November. (e) Physical examinations for onchocerciasis have been negative. (f) Culicoides sandflies were also taken in large numbers, their attack rate being much higher than that of blackflies. (g) The latter were present in significant numbers during the entire daylight period, while Culicoides sandflies occurred in numbers only during early morning (06-08 hours) and in early evening (18-20 hours). Mosquitoes were not taken in significant numbers except for the diurnal and arboreal jungle yellow fever vector, Haemagogus lucifer.

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SCIENTIFIC REPORT

1. Number of Contract: DAMD-17-75-G-9406
2. Title of Project: Assessment of the biohazards of the blackfly problem in northeastern Panama, including possible presence of onchocerciasis.
3. Duration of studies: April 1, 1976 through 30 September, 1976.
4. Objectives:
 - 4.1 Map out areas affected by the blackfly problem.
 - 4.2 Assess the magnitude of the problem.
 - 4.3 Identify the species of blackflies involved.
 - 4.4 Determine principal breeding areas.
 - 4.5 Attempt to determine presence of onchocerciasis.
5. Methodology:

- 5.1 Mapping of blackfly areas.

We attempted to outline the "blackfly belt" by spot-collecting for two or three days at different stations along the following rivers (see Map).

- 5.1.1 Bayano river, from the mouth of the Majé river upstream to the fork of the Cañazas river.
- 5.1.2 Cañazas river, from the junction with the Bayano river to the Kuna indian town of Cañazas.
- 5.1.3 The Río Diablo river, from the junction with the Río Bayano to the town of Río Diablo.
- 5.1.4 Sabanas river, from the mouth of the river to the town of Santa Fe.
- 5.1.5 Chucunaque river, at the following levels: Yaviza, Río Tuquesa, Río Membrillo, Río Mortí and Río Uala.

5.2 Assessment of the magnitude of the problem.

In order to assess the magnitude of the problem we selected an area considered "typical" within the blackfly belt, to carry out human-baited collections aimed at determining the attack rate of blackflies during a period extending from April 1, in the dry season, to August 31, in the midst of the rainy season. The study also contemplated a preliminary investigation of the diel cycle of all species involved, that would offer an indication of the hours of the day when biting could be expected to reach a peak.

For measuring the attack rate and the daily cycle of biting activity, we used two men as collectors and collections were separated in four two-hours periods: from 0600 to 0800; from 1000 to 1200; from 1400 to 1600; and from 1800 to 2000.

Collections were made by capturing flies in the act of biting, killing them with chloroform and preserving them in appropriate pill-boxes containing paradichlorobenzene.

5.3 Identification of the species.

It was early determined that although there were at least four species captured biting man at the different collecting stations, only one species was present in any numbers to be considered important as a pest or as a possible disease vector. In order to identify the species, correspondence was established with several authorities on neotropical blackflies and several attempts were made to rear adults from pupae found breeding in streams, so as to have associated material for proper identification.

5.4 Determination of principal breeding areas.

Because of the difficulties in transportation involved, only two areas were selected to search for immature stages of the principal pest species, the Membrillo river, in the Chucunaque river basin, and the Cañazas river, in the Bayano river basin. Larvae and pupae were searched in all types of running water, looking for them on rocks, live vegetation and dead vegetable matter.

5.5 Attempts at determining presence of onchocerciasis.

Because of the hostility of the Kuna indians which became aggravated in the town of Cañazas where four scientists were kept prisoners for several hours after being invited to work in the community by the chief of the tribe thus necessitating the help of the Panamanian Air Force to liberate them, the task of searching for onchocerciasis became a most difficult one. Because of the pressure brought to bear by Panamanian authorities we were finally allowed to work in the town of Cañazas. Search was also carried out in Chocó indians which inhabit the town of Membrillo and other members of that race that were examined in the town of Piriati of the Bayano river basin, outside the blackfly belt, but who had lived previously for some time at Membrillo.

Two methods were utilized for detecting onchocerciasis, through physical examinations in search of nodules and the collection of skin snips for immediate microscopic search for microfilariae in saline solution.

6. Results

6.1 Mapping of blackfly belt.

In the map, the blackfly belt appears darkened. It must be understood that fly densities were very low in localities at the edge of the belt, building up as the epicenter in the upper Chucunaque river basin was approached. However, it must be noted that even within the belt the distribution of blackflies was very erratic and the problem tended to become quite local in nature. This may indicate local and very specialized breeding areas, as well as restricted flight range of the important species. Examples of this phenomenon were found in the following areas: 1) Río Cañazas: between the junction with the Bayano river and the Kuna town of Cañazas only two areas of blackfly activity were found, one about 1 km upstream from the mouth of the river, where moderate fly densities were detected, (about 30 bites/man-hour), and the other about half way between the mouth of the river and the town of Cañazas, where high fly densities were detected (app. 80 bites/man-hour). 2) In the Mortf river there is one Kuna indian tribe which utilizes two town sites during the year. One upstream is utilized only during the dry season, when fly densities are low. As the rainy season becomes accentuated and the fly populations reach a peak, the entire tribe moves to the second site where the blackfly problem is much less severe. 3) In the Membrillo river, in the Chucunaque basin, the Government of Panama built the infrastructure for a planned settlement of Chocó Indians that had to be relocated from the Bayano river because of the formation of a hydroelectric lake. Works of infrastructures were completed late in the dry season of 1975 and the first settlers were moved in without any

major difficulties. However, when the rainy season set in, the blackfly problem became so grave that the indians refused to stay in Membrillo and the resettlement project had to be abandoned. A survey conducted by us in the area revealed that the blackfly problem in the Río Membrillo was circumscribed to the area between the junction of the Membrillo and Chucunaque rivers upstream to the fork of the Membrillo river. No blackflies were found upstream along either arm of the fork.

In summary, the following conclusions have been reached:

- a) All intense blackfly activity in eastern Panama takes place inside a belt which encompasses the upper watersheds of three rivers, the Bayano, the Chucunaque and the Sabanas (see Map).
- b) Biting activity within the belt is very local, it being restricted to areas of intense breeding of blackflies in the main streams, probably due to a short flight range of the important species. This leaves many areas within the belt free of blackflies.
- c) Biting activity is very seasonal, it being circumscribed to the rainy season. Peak of activity is reached at periods of highest water levels in the rivers, from July to November.

6.2 Magnitude of the problem.

It must be realized that, as noted above, the blackfly problem is very irregular within the belt. After sampling a number of areas the blackfly problem was found to be acute at the following localities (in order of intensity): El Martirio, Mortí, Uala, Membrillo and Cañazas (see Map).

To measure the intensity of the problem we chose a site at the Cañazas river, halfway between the mouth of the river and the

indian town of Cañazas. The site was selected on the basis of its accessibility and on the premise that it represented an average of the problem within the belt.

While originally we had planned to collect from April 1 through August 31, methodic collections could not get started until June 1, due to the continuous interference and hostility of the Cañazas indians, as well as to other logistic problems. This was unfortunate as it did not permit us to carry out systematic comparative studies on biting populations during the dry and rainy seasons. In order to at least compensate in part for this late start, collections were extended until September 30.

In Table 1 we present the total catches of blackflies captured by month, as well as the total man-hours employed and the attack rate per man-hour. As may be noted, the attack rate climbed up rapidly from June, just after the onset of the rainy season, to reach a peak in July and August, after the rainy season had set in full force and the water level in the rivers has stabilized near its maximum.

Results presented appear to back our conclusion, based on numerous spotty observations within the blackfly belt, that blackflies in eastern Panama become a pest problem only in the rainy season and that populations, which are negligible during the height of the dry season (February to April), build up gradually during May, June and July, reaching a peak from August through November, only to decline rapidly during December and January, at the onset of the dry season when the trade-winds from the Northeast increase in velocity.

It is a well-known fact that blackflies are typically diurnal feeders. That is to say, females search actively for a blood meal

only during the daylight hours. For the purpose of this project it was important to determine the peak hours of activity when they would be expected to bite in greatest numbers.

As may be observed in Table 2, in general, biting populations quickly reach pest levels (65.57 per man-hour) soon after sunrise (06-08 hours). From this period on, biting activity was maintained steadily at high levels until a peak (94.34 per man-hours) was reached in mid afternoon (14-16 hours). No collections were made in the period 16-18 hours for administrative reasons. However, captures during the evening period (18-20 hours) were negligible.

From these data it may be stated that within the blackfly belt, biting activity is maintained steadily above the pest level during the entire daylight period, with a tendency for biting populations to gradually increase from sunrise to mid afternoon, when a peak is reached, only to drop sharply at sunset.

In order to carry out side-line observations on populations of other potential vectors of human disease in the area, collectors were instructed to capture all insects which attempted to bite them. In Table 3 we present a list of all nematoceran hematophagous diptera (with the exception of blackflies) collected at the Cañazas station during June, July, August and September in 1975. As may be noted, Culicoides sandflies were captured on human bait in large numbers. In general, peak activity of these insects occurred during the first and the last daily periods of collection (06-08 and again 18-20 hours). This clustering of biting activity produced a much higher attack rate during the periods when they were present than that of blackflies, so that during periods of activity Culicoides became

an almost intolerable pest. The most prevalent species was Culicoides paraensis, which in Brazil has been suspected of being the vector of Oropouche virus, a human pathogen belonging to the Simbu group of the Bunyaviridae. This species was followed in prevalence by C. diabolicus and C. carpenteri. The former species is the main vector in Panama of the Utinga complex of viruses which also belongs to the Simbu group. The pathogenic relationships of this complex are still unknown. Culicoides are also high in the list of suspects as vectors of the human filaria Mansonella ozzardi, which has a high degree of prevalence among inhabitants of the blackfly belt of eastern Panama. These insects are also suspected of being vectors of at least some forms of monkey filariasis in the neotropical region (D. Robert Lowery, personal communication).

As far as mosquitoes are concerned, the only two species which were found in significant numbers were Haemagogus lucifer and Psorophora ferox. The former is the main vector in the area of jungle yellow fever, which last swept through this region in 1974. In the middle Bayano, H. lucifer has also been found naturally infected with St. Louis Encephalitis virus. Psorophora ferox is suspected of being the vector of a number of arboviruses in the neotropical region, particularly of Ilheus virus.

6.3 Identification of the species.

It was determined that the blackfly problem in eastern Panama is caused by one anthropophilic species. Despite all efforts displayed, it was not possible to progress beyond the tentative identification of this species offered by Dr. Pedro Wydjozinski, of the American Museum of Natural History, N.Y., who called the species as "close to Simulium sanguineum". The taxonomic status of this group of blackflies

is in a chaotic stage, so a great deal of systematic investigations will have to be carried out before definitive identification can be accomplished within the group.

It is appropriate to point out that this species complex is known from French Guiana, Surinam, Guyana, Venezuela, Colombia and eastern Panama, as far west (or north) as the upper watershed of the Bayano river.

6.4 Determination of principal breeding areas.

A search was made for the immature stages of S. sanguineum in a variety of riverine environments, principally in three areas: the Membrillo, the Mortí and the Cañazas rivers. The following conclusions may be derived from these investigations:

- a) S. sanguineum breeds only in swiftly flowing large rivers and streams.
- b) It is not found in small or slowly flowing streams.
- c) Immature stages are not found attached to rocks, pebbles, and similar structures.
- d) They are found in large numbers attached to dead leaves and twigs wedged between large rocks.
- e) They also occur, when the river waters rise, attached to live leaves that trail in the current.

Preliminary tests for control consisting in sinking into the river waters Plaster of Paris bricks saturated with a solution of Abate, were carried out in Membrillo. The method proved to be promising, as 24 hours after sinking the bricks, no larvae could be found as far as 500 mts downstream.

We were also informed that some 15 years before, at Membrillo,

a Dutch banana company was successful in reducing adult populations by airplane spraying. However, we could not find out what adulticide was used, but presumably it possibly was DDT.

6.5 Attempts to determine presence of onchocerciasis.

The following communities were examined for blindness and for presence of nodules on head and body and/or dermatitis of various types (see Map):

- a) Mortí
- b) Uala
- c) Membrillo
- d) Cañazas
- e) Piriati

The first four communities were selected because they represent inhabited areas with the highest densities of blackflies nearby. Piriati was included because after the failure encountered in the colonization of Membrillo, the Chocó indians from Membrillo were relocated in Piriati, within the Bayano river basin, outside the blackfly belt.

The communities of Mortí and Uala were examined in 1967 during a study done for the U.S. Army as part of the feasibility studies for an interoceanic sea-level canal along the projected route 17. Results given are based on general field notes as the exact data obtained could not be located.

In Table 4 we present the age structure of two populations examined during the present studies, one, Membrillo, a Choco indian community of the Chucunaque river basin in the process of being settled, and the other, Cañazas, a long settled and stable Kuna town in the Cañazas

river within the Bayano river basin.

Results of Piriati again are based on field notes taken during the survey. This is the only place where skin snips were taken of persons who had resided in the abandoned Membrillo site in 1975.

Following are the results of the survey by community:

a) Mortí and Uala: These two communities constitute the nucleus of the remnants of the Kuna race in Darien. They are settled on the Mortí and Uala rivers, respectively, which are tributaries of the headwaters of the Chucunaque river (see Map). These communities are the most isolated of all Kuna tribes, both geographically and socially. They conserve many of the primitive traits of their race, including the strains of maize they raise, which is considered by INCAP to be one of the most primitive in the Western Hemisphere. They live in isolation, protected from civilization by their hostility, by the remoteness of their communities and by the hordes of blackflies which make life impossible for anybody else. They have lived with this problem for such a long period of time that they tolerate it rather well. At the height of the fly season they paint their entire bodies with a black vegetable dye which is said to be a repellent against the flies.

In 1967, during the Interoceanic Canal studies, we were fortunate to be allowed to work in these communities after controlling with drugs a devastating epidemic of malaria. We were able to do physical examinations and to bleed more than 100 people, men, women and children, which represented about 60% of the population. We were particularly looking for blindness, nodules in all parts of the body and dermatitis. No blindness or nodules were found. Inquiries with the dignitaries

of the tribes revealed that blindness among these indians is almost unknown. The only skin problem noted was a discoloration of the skin of the extremities, particularly of the hands, in some 75% of the people examined. The ailment was tentatively diagnosed as Pinta. Sera collected were submitted to the V.D.R.L. test resulting in 95% positives. These results seem to confirm the diagnosis of Pinta. The possible relationship of blackflies and Pinta in these communities deserves further investigation, as hyperenzootic Pinta is unknown elsewhere in Panama. Although no skin snips were examined, there is no reason to believe that onchocerciasis occurs in these communities.

b) Membrillo: This community was located on the right bank of the Membrillo river, near its last fork before its junction with the Chucunaque (see Map). Table 4 presents the structure of the population, which was entirely made up of Chocó indians. As may be noted from data presented, there was an overwhelming majority of males in the age group 15-30, which represents the laboring group. The reason for this is that the community was in the process of settling as part of a project to transfer the Chocó indians that were going to be affected by the damming of the Bayano river for a hydroelectric project. Plans called to improve the life style of the resettled Chocó indians by concentrating them in a community on the Membrillo river, which was to be called "Nuevo Bayano", where some of the basic services of health, education and agricultural advice could be offered. Resettlement had begun in December, 1974, about 7 months before our visit. At this early stage in development, the population consisted mostly of young males which were engaged in putting up the necessary infrastructure for resettlement. In the long run this project failed at the end of

1975 because the indians could not tolerate the blackflies.

A sample of 100 persons (60% of the total population) representing the actual structure of the population were examined and bled. No cases of blindness and no nodules were detected. There was a widespread hyperkeratosis of the forearms and hands, which seemed to be related to the numerous bites of blackflies being received. Serology for Chagas disease ran on the 100 sera revealed two four-plus positives, a male of 23 and a female 40-years old. No evidence of the presence of onchocerciasis could be found.

c) Piriatí: This community is located in the upper Bayano river basin near the shores of the newly formed Bayano lake, and on the Panamerican Highway under construction. The community, which is entirely made up of Choco indians, is outside the blackfly belt, but persons who abandoned the Membrillo were resettled in it. During 1977 several visits were paid to the townsite in order to follow up people that had been exposed to blackflies in the past. More than 100 persons have been examined to date with no signs of blindness, nodules or widespread dermatitis. A biased sample of 12 individuals were selected for skin snips examination, on the basis of having being exposed the longest to blackfly bites. No microfilariae could be found in any of the snips examined.

d) Cañazas: This is a small Kuna community located in the upper watershed of the Bayano river, on the right bank of the Cañazas river, main tributary of the Bayano river. The area was visited twice in the dry season of 1976. Four scientists went in the first trip, being carried in by a Panamanian Air Force helicopter, because of the remoteness of the area. Nothing could be accomplished during

the first trip because of the open and aggressive hostility of the indians (see above). One scientist returned a second time making the hazardous three-day trip up the Bayano and Cañazas rivers in a dugout canoe. This time he was well received and was allowed to stay two nights. Table 4 indicates the structure of the population examined. No signs or history of blindness were found and no nodules or widespread skin diseases were detected. The only abnormal health situation in the community was an epidemic of bacterial conjunctivitis, undoubtedly transmitted by massive populations of Hippelates flies found in the town.

It is concluded that there is no reason to believe that onchocerciasis is present in the blackfly belt of eastern Panama.

Conclusions:

From data presented above it may be inferred that, although Onchocerciasis does not appear to be present in the region, densities of blackflies reach such high levels that they may become almost intolerable pests.

In case of an emergency that may require the movement of large numbers of people through the area, certain facts about the blackflies must be kept in mind. These are:

a) There appears to be a relationship between the spirochaetal disease "Pinta" and high densities of blackflies in the Mortí and Uala rivers, in the upper Chucunaque basin. It is, thus, conceivable that the disease may spread rapidly among people moving close to the indian population of these areas, particularly if there is mechanical transmission by the flies.

b) The blackfly problem in eastern Panama is limited to a belt covering the upper watershed of the Bayano, Chucunaque and Sabanas rivers,

shown in dark on the map.

c) The problem is seasonal, being felt during the rainy season only, worsening when the water in rivers reach maximum levels on the months between August and December.

d) Blackflies bite only during the daylight hours. However, in some areas of the blackfly belt, like in the Cañazas river, blackflies occur together with Culicoides sandflies or "no-seeums" which bite during twilight and in the evening, being as much of a pest (or a worse one) as blackflies.

e) The blackfly problem is not evenly distributed throughout the belt, as there are areas within it completely free of flies. So, in planning camping activities for large numbers of people, spot-checks should be made ahead, so as to insure that camping sites are located in blackfly-free areas.

TABLE No. 1

HUMAN-BAITED COLLECTIONS OF BLACKFLIES IN THE RIO CAÑAZAS (BAYANO)
FROM JUNE THROUGH SEPTEMBER, 1975

<u>Month</u>	<u>June</u>	<u>July</u>	<u>August</u>	<u>September</u>	<u>Totals</u>
Total man-hours	306	446	458	408	1,618
Total flies collected	5,871	28,000	41,812	36,039	111,722
Bites/man-hour	19.19	63.64	91.29	88.33	81.05

TABLE No. 2

DIEL CYCLE OF BITING ACTIVITY OF BLACKFLIES
RIO CAÑAZAS (JULY THROUGH SEPTEMBER, 1975)

	Hours		
	06-08	10-12	14-16
Bi-hourly periods of collecting	06-08	10-12	14-16
Man-hours of collecting	330	334	642
Number of flies taken	21,639	23,644	60,568
Attack rate per man-hour	65.27	70.79	94.34

TABLE No. 3

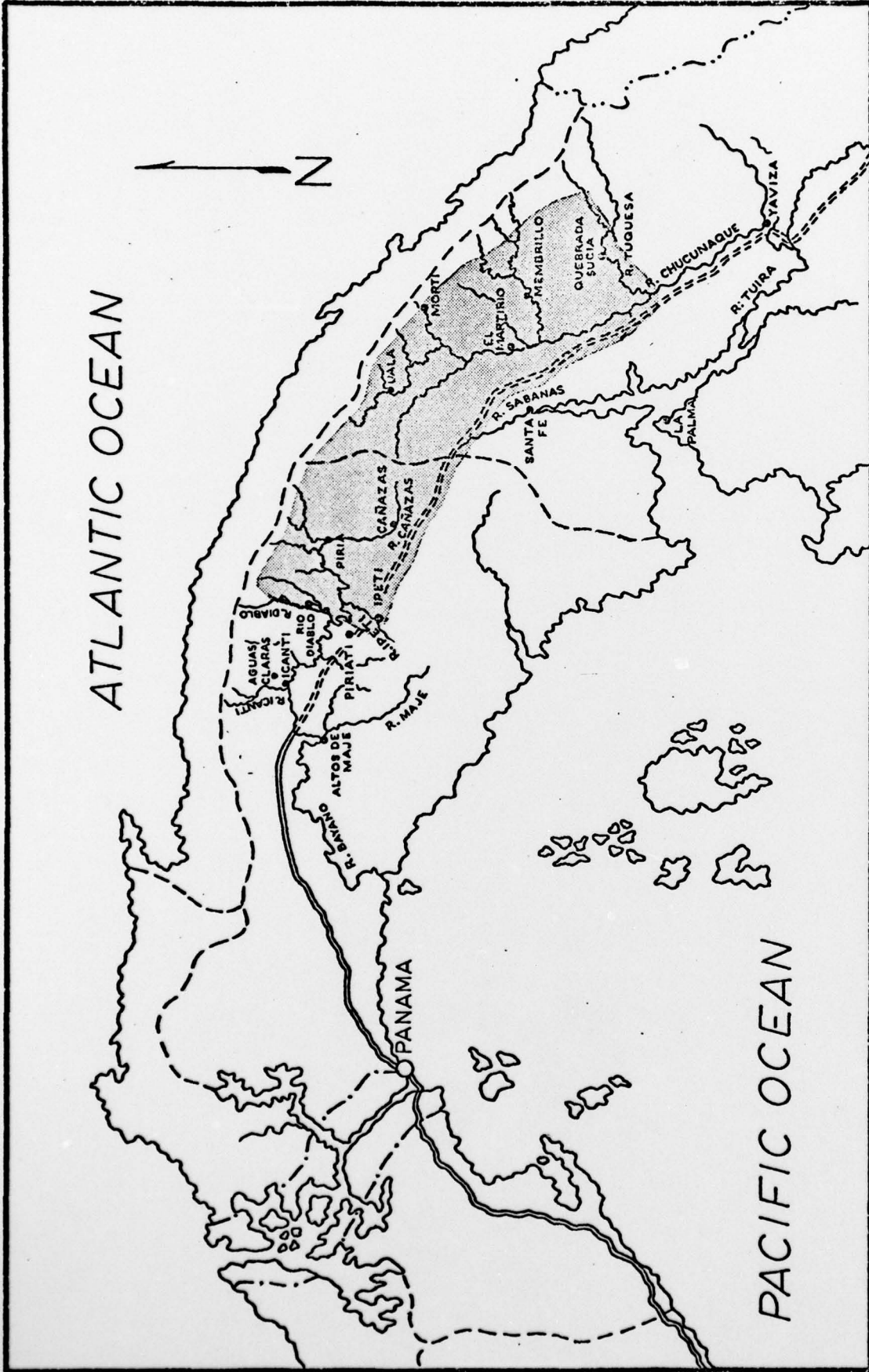
TOTAL OF OTHER HEMATOPHAGOUS NEMATOCERAN DIPTERA COLLECTED AT THE
RIO CAÑAZAS WITH HUMAN BAIT (JUNE THROUGH SEPTEMBER, 1975)

1.	<u>Culicoides sp.</u>	53,369
2.	<u>Chagasia bathana</u>	1
3.	<u>Anopheles triannulatus</u>	6
4.	<u>Anopheles apicimacula</u>	41
5.	<u>Anopheles punctimacula</u>	1
6.	<u>Limatus flavisetosus</u>	9
7.	<u>Limatus durhamii</u>	3
8.	<u>Wyeomyia spp</u>	26
9.	<u>Sabethes chloropterus</u>	4
10.	<u>Trichoprosopon longipes</u>	3
11.	<u>Aedes fulvus</u>	4
12.	<u>Aedes fluviatilis</u>	2
13.	<u>Aedes sexlineatus</u>	9
14.	<u>Aedes angustivittatus</u>	33
15.	<u>Psorophora ferox</u>	292
16.	<u>Psorophora albipes</u>	8
17.	<u>Psorophora cingulata</u>	2
18.	<u>Psorophora cilipes</u>	1
19.	<u>Haemagogus lucifer</u>	870
20.	<u>Haemagogus equinus</u>	43
21.	<u>Haemagogus clarki</u>	3
22.	<u>Mansonia indubitans</u>	4
23.	<u>Mansonia titillans</u>	6
24.	<u>Coquillettidia nigricans</u>	1
25.	<u>Culex corniger</u>	2
26.	<u>Culex declarator</u>	3

TABLE No. 4

POPULATIONS EXAMINED IN TWO INDIAN COMMUNITIES OF
EASTERN PANAMA FOR ONCHOCERCIASIS

Age Structure	C O M M U N I T I E S			
	Membrillo (Chocoes)		Cañazas (Kunas)	
	M	F	M	F
0 - 6	0	0	11	1
7 - 14	10	2	3	5
15 - 30	64	13	5	12
31 - 49	6	2	4	6
50 - 65	2	1	3	1
Total	82	18	26	25
Appr. % pop. exam.	50%		60%	



EASTERN PANAMA BLACK FLY-BELT